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EVERY MAN HIS OWN TEACHER;

OR,

LANCASTER'S
THEORY OF EDUCATION,

PRACTICALLY DISPLAYED;

BEING

[illegible] INTRODUCTION TO ARITHMETIC,

WRITTEN IN THIRTEEN PARTS.

TO WHICH ARE ANNEXED,

[illegible] TWO CARDS OF LESSONS,

TO BE SUSPENDED IN THE SCHOOL-ROOM CONFORMABLY TO THE

LANCASTER PLAN.

THE WHOLE IS CALCULATED FOR THE USE OF FAMILIES DESTITUTE
OF A SCHOOL, FOR SCHOOL-MASTERS, AND FOR THE
AMUSEMENT OF PRIVATE GENTLEMEN.

[illegible] BY JOHN PRESTON.

ALBANY;
PRINTED AND PUBLISHED FOR THE AUTHOR.

E. & E. Hosford....Printers,
1817.

Educ 2310.117
MAY 23 1940

Southern District of New-York, ss.

BE IT REMEMBERED, That on the fifteenth day of May, in the forty-first year of the Independence of the United States of America, John Preston, of the said District, hath deposited in this office the title of a Book, the right whereof he claims as Author, in the words following, to wit:

L.S.

"Every Man his own Teacher; or, Lancaster's Theory of Education, practically displayed; being an Introduction to Arithmetic, written in thirteen parts. To which are annexed, Thirty-two Cards of Lessons, to be suspended in the School-room, conformably to the Lancaster Plan. The whole is calculated for the use of families destitute of a school, for School-masters, and for the amusement of private Gentlemen. By John Preston."

In conformity to the Act of the Congress of the United States, entitled "An Act for the encouragement of Learning, by securing the copies of Maps, Charts, and Books to the authors and proprietors of such copies, during the time therein mentioned." And also to an Act, entitled "An Act, supplementary to an Act, entitled an Act for the encouragement of Learning, by securing the copies of Maps, Charts, and Books to the authors and proprietors of such copies, during the times therein mentioned, and extending the benefits thereof to the arts of designing, engraving, and etching historical and other prints."

THERON RUDD, *Clerk*
of the Southern District of New-York.

TO

HIS EXCELLENCY

DE WITT CLINTON, ESQUIRE,

GOVERNOR OF THE STATE OF NEW-YORK.

SIR,

HAVING a knowledge of your efforts and zeal in promoting the useful Arts and Sciences, and at a time when they are needful for the continuance of prosperity under a free government; when pretensions to political good, *are too often substituted for* real patriotism;*—I venture to inscribe to you this work, introductory to the different Systems of Arithmetic, for perusal and approbation.*

Hoping at the same time, that your labours, together with the influence of Gentlemen who are friendly to the education of youth, and to the equal rights of man, will be so far blessed, as shall cause the rising generations to know and practise those precepts which will not benefit a few only, but such as will augment the interest, the prosperity, and the happiness of all.

JOHN PRESTON.

Albany, July 1, 1817.

WOULD it not be desirable to extend and establish this System of Education, before we lose sight of its usefulness?—before party prejudices may prevail, and keep the grand *desideratum* hidden from the world? It is highly important that the experiment should be fairly made, while the minds of Americans are in favour of those plans which promote Freedom in preference to Tyranny:—For, it is not to be expected that Monarchs will foster the institution; because, the diffusion of knowledge ultimately terminates in their destruction, and throws civil government into the hands of the people, whence the *God of Nature* has ordained it should originate.

THE present performance is intended as an easy Introduction to Arithmetic, to facilitate that useful art upon Lancaster's plan or otherwise, as circumstances may require in common schools or private families. The Author offers it as the result of long acquaintance with the subject, and no inconsiderable experience as a Teacher; and confidently hopes that it will be found to answer the ends intended. His method being new, he has no doubt but that he hath still left room for improvement by abler hands: but let it be remembered, that Men of great genius, or of great reputation in the literary world, generally engage in more dignified pursuits, soar above rudimental improvements, and omit some of the most important duties of moral rectitude; or, in other words, they are contented in leaving the youths, of whom the future great men of the country must be formed, to grope in the dark, or be subject to the Tyranny of those whose minds are too narrow to encourage real facilities in the arts of "teaching young ideas how to shoot."

That the success attending the system, of which this is a part, may even exceed in America what has been indicated in England, and that the poor of all countries, may become as well informed as the rich, is the ardent hope, and sincere wish of the

AUTHOR.

State of New-York,
Albany County, March 1816.

ADVERTISEMENT.

[illegible] written in thirteen parts, with a view to benefit a great [illegible] scholars with one copy only; for, ten or twelve learners, that is, one class may work from one part, while another class of ten or twelve may work from a separate part; thus if there are a sufficient number of different classes, possessing different degrees of knowledge in figures, the book will conveniently serve more than one hundred pupils.

Schoolmasters may therefore signify their choice, and receive a book full bound, with all the parts in one volume, or they may have the parts stitched and bound separately with strong paper, in form of a neat pamphlet. They may also subdivide these pamphlets at pleasure.

Page 18, at the end of line 3, omit the words "or multiplied."

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OBSERVATIONS,

To be read by Teachers, and then deposited in their desks.

1. It may not be convenient for every Teacher to procure my spelling book, nor Lancaster's description of this plan for educating children;* therefore the following sketches will be of use, by enabling Teachers to perform [illegible] herein directed, till those books can be obtained.

2. The scholars are to be classed according to their age and abilities, with ten or twelve in a class. In full schools the boys and girls are classed on separate seats *by themselves.* Each one has a slate and pencil. The slates are without frames, and generally let into the writing bench even with the surface. Here let us digress [illegible] moment: Benches, or writing desks, as you please to call them, are universally constructed too much aslant; therefore, when new school-houses are to be erected, it will be necessary to employ some discreet superintendent. Able Teachers of about thirty or forty years of age, will be most likely to have observed deficiences, and be ready in giving directions, respecting the length, breadth, and inward formation of school-houses. Three degrees of inclination for a writing desk, I have found, by experience, to be the most convenient. By this construction, the writer will sit more naturally, with a greater degree of ease, and the implements will remain in their places.

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* Which are for sale at the Bookstores, in Albany.

3. When boys in a reading class, can spell words of two syllables, they may go occasionally into a ciphering class, for half an hour or more at a time. This change will create an amusement; it will invigorate the mind, and render tasks delightsome: for as the body grows weary by remaining too long in one posture, so the mind becomes tired by pursuing a particular object. The old *dogma*, of not allowing scholars to calculate with, and combine numbers, till they have become great proficients in reading and penmanship, is done away by the Lancastrian plan or mode of teaching.

4. But let us return to our ciphering class: After a class is formed, place an overseer behind the class, with a slate and pencil, to superintend the whole. His business will be to instruct every scholar how to arrange the work on the slate, and how to begin and finish the operations with accuracy. The most expert boys in each class, will also aid the overseers when cases render the same needful.

5. These superintendents, by Lancaster, are called *Monitors;*[*] and there are higher monitors that preside over *senior* classes, whose duty it is now and then to inspect the *younger* classes. These higher monitors, with the advice of the principal Teacher, will remove scholars from one class to another when they become acquainted with the rule, or particular part of the rule, they are working in; but those who do not understand the rule, must remain in the same class till they can pass examination. The criterion whereby to know when a boy is fit for removal to a

---

[*] When a monitor forfeits his place by inattention to duty, another is appointed; which appointment dishonors the first monitor.

higher class, is his being able to write a lesson and form a a Key to the same.

6. See an example in Simple Addition.

14 Apples.
21
34
15
———
84

The boy writes as follows: "I begin at the 5 and say, 5 and 4 are 9, and 1 is 10, and 4 are 14; set down 4 and carry 1, because there is one time ten in 14."

Then I say, 1 that I carried and 1 makes 2, and 3 are 5, and 2 are 7, and 1 is eight; I set 8 on the left side of 4, which makes 84; the amount of the apples; or sum total of the apples."

7. When a scholar can do this or something similar without assistance, he may be advanced to another class.

8. The usual method of teaching on the Lancaster plan, is to have a card of lessons suspended before the scholars in plain view; then each one writes and copies the card according to the directions of the monitor.

EXAMPLE.

1, one: 2, two: 3, three: 4, four: 5, five: 6, six: 7, seven, &c. till arising to a hundred or more.

9. When writing these numbers, the pupils must be taught how to read them, thus: 12; begin at the 2 and say, "units, tens; twelve." Again, 76; begin at the 6 and say, "units, tens; seventy-six." 101; begin at the 1 on the right hand and say, "units, tens, hundreds; one hundred and one. 1815; begin at the 5 and say "units,

tens, hundreds, thousands; one thousand eight hundred and fifteen."

10. The principal Teacher or some one of the expert monitors, will lecture noviciates in this manner, till they can read four figures correctly: Then have the Numeration Table suspended to view, and let some little ambitious gentleman place half a dozen or more of his comrades in a semicircle, near the card hanging by the wall, and, with a long pointer or wand, teach them the numbers, and how to read the same.

11. This can be done in the way of pastime, for it will rest their weary limbs by changing their posture of sitting on a bench, to that of standing erect.

12. When learners become advanced to those cards which have a key, they will copy a lesson from the card as the monitor directs; and the monitor will see that the figures are correctly arranged on their slates.

13. Then the monitor will begin to read the key, and the class will work by his reading, having the card to look at as a guide; he will also have an eye to their performances, and see that each scholar attends to every particular part thereof with exactness.

14. The cards may be cut out and hung up by the wall or in any convenient place before a class; but if the owner chuse, he may take copies occasionally and let the book remain entire.

15. It is also expected that teachers will form many more lessons than are herein printed; and those new lessons,

ought to be composed according to the capacity of the learners for which they are designed.

16. A few examples in combination of figures are inserted as a specimen: First suspend one or two cards before the class in such position, that every one may view the figures with ease; then the monitor writes on his slate and shows the whole class how they must proceed.

EXAMPLE.

4 and 2 are 6; 3 and 2 are 5; 6 and 1 is 7; 5 and 2 are 7; 8 and 1 is 9.

After this simple mode of working with easy tasks, introduce something in a small degree more difficult; as 2 and 4 are 6 and 1 is 7, and 2 are 9, and 3 are 12, and 1 is 13, and 3 are 16, and 2 are 18, and 1 is 19, and 2 are 21, &c. till the little tender minds become capable of reflecting and calculating independently.

17. Then proceed with larger numbers, but always have due regard to the capableness of learners: For instance; when a class have written some considerable time on one particular series, suppose it to be clause 16, or a whole card similar thereto, give them a task which will require a more strict attention; such as, 4 and 3 are 7, and 3 are 10, and 4 are 14, and 3 are 17, and 4 are 21, and 5 are 26, and 4 are 30, and 6 are 36, and 3 are 39, and 4 are 43, &c.

18. But when we are about to make these advances, it will be proper to examine the class, one by one, as follows: Order them to clean slates; this may be done with a piece of moist cloth, a piece of hat, or a sponge; then turn the

blank side of the card to view, and begin with No. 1, or head of the class, and from the key, or from one of the cards, form questions thus; "4 and 2, how many? 3 and 2, how many? how many are 5 and 2, and 1?"* Examine their slates and see who is right, and who has erred. Let there be no partiality in forming these questions when they are independent of the card or key, and let the scholars go up and down as in spelling classes. This operation will enable the principal Teacher to know how far he may increase the magnitude of the figures in his next lesson. And he will also be able to determine, how many scholars may be moved to a higher class.

FIGURES TAUGHT WITHOUT A BOOK.

19. There is a mode of teaching children in arithmetic *without* a book; this mode I will endeavour to describe. Take a smooth board of about two feet in breadth and three feet in length, suspend it on a nail by the wall, and place a dozen spare slates by the board: then let the Teacher, or some of the capable monitors, with a piece of chalk, write a lesson in figures on the board, suitable for the scholars who are to be called before it for exercise.

20. When this is done, name such a class as you think proper; suppose it will be No. 3.—"No. 3, to the side-board calculation." When they become noisy by incautious steps, stop them without delay—they ought to come from their seats in order as they there sat: each one with his pencil, expeditiously, but cautiously, without noise, approaches the sideboard, takes a slate, and the whole

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* See Card No. 16.

form in a semicircle. The monitor then begins after the manner described in clause 21. But in order to make the business plain to every capacity, let us have a lesson in view.

We will take a *lesson*, or *task*, or *sum*, as you please to call it, in Simple Addition, which suppose stands marked on the sideboard thus:

3	4	2	5
3	2	5	1
5	3	2	4
4	2	3	2
2	5	4	3
3	4	5	2
5	3	1	4

Here we chuse figures of small numbers to encourage the pupils.

The mode of teaching every branch of science, ought to be such as will make it pleasing to the learner, so far as the nature of things will admit.

21. Now we will describe the duty of the monitor: He stands behind the class with a wand, or long handsome stick for a pointer, and directs No. 1, or head of the class, to add the first right hand column of figures. No. 1 proceeds as follows: "4 and 2 are 6, and 3 are 9, and 2 are 11, and 4 are 15, and 1 is 16, and 5 are 21; set down 1 and carry 2 to the next column, because there are twice 10 in 21."

Then the Teacher will begin a lecture thus: "As the second column is ten times greater than the first, and the third is ten times greater than the second, and the fourth is ten times greater than the third, so whatever is carried forward from column to column, must be called ten or tens. When we have 14, we set down 4 and carry one time ten, because the 4 is four above ten, and there is one time ten in 14. If we have 35, set down 5 and carry 3, because there are 3 tens in 35. For 47, we must set down 7 and carry 4, because there are 4 tens in 47." These, and similar observations, should be made to arithmetical classes whenever time will admit. But we will attend to the calculation again. The second boy, No. 2, in the semicircle, says, "2 that I carry, and 1 is 3, and 5 are 8, and 4 are 12, and 3 are 15, and 2 are 17, and 5 are 22, and 2 are 24; set down 4 and carry 2 to the next, because there are twice 10 in 24." The residue of the class take their turns in adding up a column; but as No. 4 adds up the last column, No. 5 must begin with the first column, in the manner that No. 1 began the same; then No. 6 will add the second column. No. 7 the third, No. 8 the fourth, &c. in rotation till they have had an equal share in exercising their faculties.

22. When a new task becomes expedient, deface one or two figures in each column with a piece of sponge, or cloth moistened in water, and replenish those vacancies with different figures. If we perceive a readiness or expertness in a majority of the class when calculating, then it may be proper to fill those vacancies with higher numbers; but here let it be repeated, that, such steps or enlargements *must* be made with caution; without advancing too far at a time; lest we embarrass the young minds, retard their progress, and create a discouragement.

23. This last mentioned evil has been prevalent from time immemorial; but that era is fast approaching, when the whole circle of science will be divested of puzzling, mysterious, and partial schemes.

24. In the next place we will suppose an older class are called up to the board, and that they are as ready in say-

ing "8 and 7 are 15, and 9 are 24, and 7 are 31;" &c. as the others were in saying "4 and 2 are 6, and 3 are 9, and 2 are [illegible]." In this case, let the lesson on the board consist of more columns, and of more and higher figures in each column. But in all cases beware of extravagance, that time may not be taken up in unuseful projects; that is, in calculating such hard or uncommon lessons, which seldom or never happen in ordinary practice. Usefulness and despatch are objects aimed at by all advocates for Lancaster's method of education.

AN ADDITIONAL METHOD.

25. There is an *improvement* in teaching arithmetic on Lancaster's plan, and for the satisfaction of readers, a lesson is hereunto subjoined.

AN EXAMPLE IN ADDITION.

4_{28}	3_{25}	4_{26}	1_{18}	3_{27}
5_{24}	6_{22}	4_{22}	8_{17}	6_{24}
6_{19}	2_{16}	7_{18}	1_{9}	4_{18}
5_{13}	4_{14}	3_{11}	2_{8}	9_{14}
6_{8}	8_{10}	7_{8}	4_{6}	5
2	2	1	2	
28	5	6	8	7

26. I submit this mode of operation to the judgment of Teachers, and will let them make use of it as they think proper in a few of the first lessons.

The first six cards of this book will nearly supersede the necessity of resorting to this mode of calculation, and clause 18 will show how to determine when a scholar may be advanced to a different degree of lessons. Another alteration different from Lancaster's mode is this, add immediately whatever there be to carry to the next column, instead of reserving it till you have added [illegible] [illegible]

27. THE PESTALLOZZIAN PLAN.

I will mention this plan for exercising the mind on calculation, and then proceed to the government of a school.

The seven subjoined periods form a characteristic extract from a book entitled, "Sketch of a Plan and Method of Education, founded on an Analysis of the human Faculties, and Natural Reason, suitable for *The offspring of a Free People*, and for all Rational Beings. By JOSEPH NEEF, formerly a coadjutor of Pestallozzi, at his school near Berne, in Swisserland.

Philadelphia: Printed for the Author, 1808."

The characteristic periods are as follow:

"There lives in Europe, beneath the foot of the Alps, an old man, whose name is PESTALLOZZI; a man as respectable for the goodness of his heart, as for the soundness of his head. This man, endowed by nature, or rather nature's God, with the felicity of an observing mind, was forcibly struck with the vices, follies, and extravagancies of the superior ranks, and the ignorance, superstition, and debasement of the inferior ranks of society. He perceived that from these impure sources flowed all the miseries that afflicted his unhappy fellow-creatures. Being no disciple of Zeno, the woes of his brethren naturally imparted their anguish to his sensible heart.

"The host of calamities under which he saw his fellow-men groaning, deeply grieved his feeling soul, and the gulph of evils into which he viewed mankind plunged, called forth the most cordial and sincere compassion.

Tears fell from his mourning eye, but they were manly tears. Far from being disheartened by such a sad spectacle, he had the courage to enquire into the causes of human misery; he went even a step farther, and endeavoured to find out an* wholesome remedy, calculated to destroy at their very source, those evils which inundated the world."

This is the Patriot and Philanthropist, who invented an advantageous System of Education, to be pursued by every class, from the novice to the profound scholar.

I will give a hint of this method, and that in calculation only.

MODE OF OPERATION.

Instead of figures, let boys make use of peas, beans, kernels of Indian corn, short pieces of sticks, leaves of grass, *of* weeds, or any other convenient materials. To a certain number of these objects, add another number, then count how many there are in the whole: call this the sum total. From another number of these objects, take away a certain number, and ascertain how many are left: call this number which is left, a remainder. Thus we can perform *Addition* and *Subtraction* with real objects, instead of those which are imaginary.

This exercise will afford children pastime when they are out of school; it will keep their minds intent on the business they are sent to perform, and will not disappoint their guardians, nor grieve their hard-labouring and frequently indigent parents.

But these two rules are not all that can be performed by moveable objects without figures. Multiplication and

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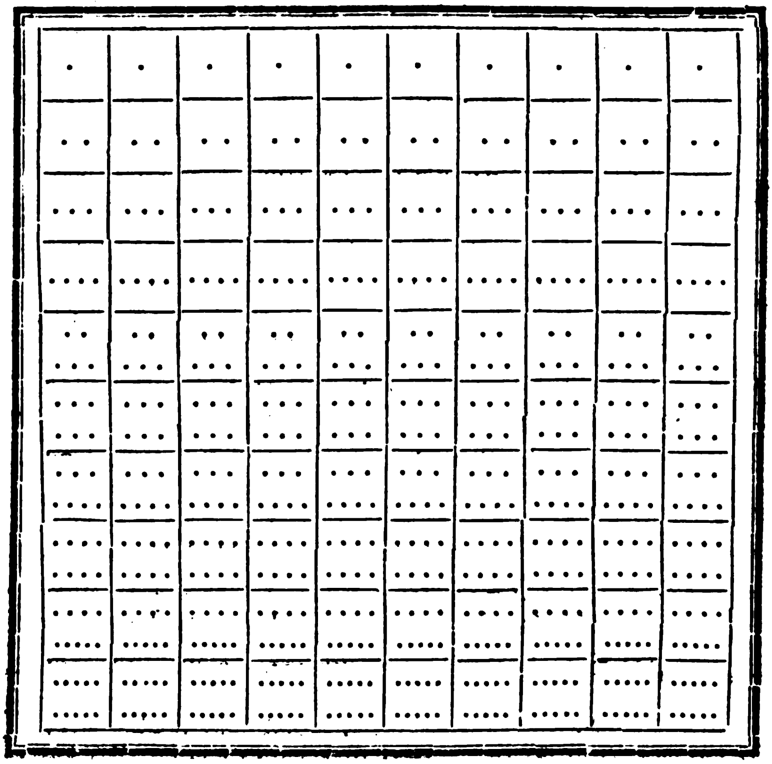
* When h is sounded, *a*, is preferable to *an*.

Division, may be wrought with the same materials on a checker-board about two feet square; and this may be done to a considerable greater degree of profit, than is commonly received from the operations played on that fascinating time-waster.

28. By this board we can solve the following problems, and perhaps thousands more.

How many times one will two times two make? Two times two are four, and four times one are four. Answer, four times.

29. How many times one can we make of three times two? Three times two make six, and there are six times one in six. Answer, six times.



30. How many times one are four times two? Count off four times two: now how many have you? Answer, eight. Then four times two are eight. Well, how many times one are two times four? Count the first parcel of four; this is one time four; count on five, six, seven, eight; now we are through the second parcel of fours; how many are there? Answer, eight. Right, the same as the other; two times four are eight, and four times two are eight: this proves the work to be done right.

31. Let us make a new lesson. How many times one are three times three? Look at the three parcels of three: one, two, three, four, five, six, seven, eight, nine. Ans. 9.

32. How many times one will four times three make? Three, and three are six, and three are nine, and three are twelve. Answer, twelve.

33. How many times one are there in four times four? Look at the parcels of four, place your finger down at the end of the fourth parcel; now count how many there are till coming to your finger. Sixteen. Right. Then four times four make sixteen, or sixteen times one.

34. How many times one are two times eight: Look at two parcels of eight: count them: how many do they make? Sixteen. Right. Then two times eight are equal to four times four. Can you tell me how many eight times two will make? Count off eight parcels of two: how many do they make? Sixteen, the same as two times eight. That is right; figures will prove one and the other when reckoned right. Four times four are sixteen, two times eight are sixteen, and eight times two are sixteen.

35. I wish to know how many times one three times five will make? Count off the first, second, and third parcels of five: how many? Fifteen. Well, how many times one will five threes make? Count off five parcels of three. Five threes make fifteen also, the same as three fives. All right.

36. DIVISION.

Now we will try to perform Division with our checker-board.

How many times two are contained in eighteen? Place your finger at the end of eighteen on the range of twos; how many times two are there in that space or range till coming to your finger? Answer, nine.

37. Count off thirty on the parcels of five: How many times five in thirty? Answer, six.

38. How many times eight in forty? Count off forty on the parcels of eight: how many times eight? Five.

Count off forty-eight on the same range. How many times eight? Six times.

39. In forty-nine, how many times seven? Count off forty-nine on the range of sevens; how many times seven are there? Seven times. Then seven times seven are forty-nine: all right.

40. I have sixty-four chestnuts, and wish to divide them among eight boys; how many times eight are there in sixty-four, and how many will each boy have? Count off sixty-four on the range of eights: how many times eight are

there? Eight times. Then each boy must have eight. Give eight to each one and see if the operation will prove in the result.*

41. Suppose I have forty-two walnuts, and wish to divide them equally among six boys; how many can each one have? Count off forty-two on the range of sixes: how many times six are there? Seven.

42. Nine cakes cost forty-five cents: how much was that apiece? Count off forty-five on the range of nines; how many times nine are there? Five times. Right, the cakes cost five cents each.

43. I have fifty-six pencils; how shall I divide them that seven boys may have an equal number each? Count off fifty-six on the range of sevens: how many times seven are *there*? Eight times. Very well, each boy must have eight pencils. But, here comes little George Sprightly; will you all consent that I divide them again and give him an equal share? Agreed.

Now there are eight of you: how many must each one have? Count off fifty-six on the range of eights: how many times eight are there? Seven. Right, each one must have seven pencils, because seven times eight are fifty-six.

44. These questions are only a small number of specimens for the Teacher; he may exercise his ingenuity in forming different lessons, and of such variety, as his judgment will direct from time to time for the benefit of pupils. Exercising questions similar to the following, may be

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* Here explain *result*, and use no technical terms without explanation.

given out occasionally to advantage. As, four more three, that is, four added to three, equal how many?

45. Four, more three, more two, equal how many?

46. Four, more three, more two, less one; that is, one subtracted, equal how many?

Six, more three, more two, less one, equal how many times five?

47. Eight, multiplied by two, equals how many?

Eight, multiplied by three, less four, equals how many times ten?

48. Four, more the half part of two, equal how many?

49. Fifteen, less five, gives a certain sum for a remainder: how many times five equal that remainder?

50. The third of twelve, more the one half the third of twelve, equal how many?

51. The third of forty-eight, and half the third of forty-eight, are equal to how many times six? The fourth part of eight, more the third of fifteen, more the half of eighteen, equal how many times the half part of eight? 4.

52. The younger classes, under the inspection of some one from a senior class, may be exercised with such simple, easy, and diverting questions, and save much time, which otherwise would be worse than lost; for this employment at home and at school, will often keep them out of mischief; it will exercise their mental faculties, and teach

them how to distinguish truth from error; it will facilitate an attainment of the knowledge of the multiplication table suspended by the wall, and it will aid in expediting, that which is already an expeditious mode of teaching and learning arithmetic.

53. The Teacher may use his ingenuity in contriving such lessons as will suit every class designed for this mode of working, and compose the latter part of lessons progressively easier or plainer than the first, that the inexperienced of the class may not grow discouraged, by being unable to answer questions as well as the more knowing. This variation in the lessons cannot be justly construed as partiality, because these exercises are separate from the common tasks in school.

54. If business be so pressing that the Teacher cannot attend to these simple, though in the sequel, important manœuvres, let him call on some of the able monitors to prepare a lesson on paper, for any certain class or number of classes who are designed for an airing, and give directions to their overseers how to proceed.

55. As to a general rule for pastime, I chuse to be liberal, especially in the summer season, and endeavour not to confine them in school, except as a punishment for crimes more than two hours at a time; and wish to come short of that, if business render it convenient. When they first approach that delightsome and healthy element, the open air, let each class form separately in a ring, with their overseer in the centre; he will then read to them the first question to be solved, two or three times, very slowly and distinctly; he will also inform them that in case No. 1;

the head of the class miss in answering, then the first next who answers right, will go head.

They will then run or walk as they please within due bounds, and return to their former circle; the overseer there makes ready with his checker-board, and the head of the class comes up first; if he has studied out the solution, let him manifest it, if not, he may have recourse to the board; if he then answers correctly, he remains head of the class, but if not, the next in rotation, No. 2, takes *his* turn; if *he* answers right, he goes head.

56. The overseer then reads the second question; they all run, walk, skip, hop, and recreate themselves a minute or two, return to the circle and proceed in the manner of a spelling class as to precedence: in this way let them exercise themselves fifteen or twenty minutes in the forenoon and afternoon.

57. If any objection arise respecting scantiness of time, the Teacher will please to recollect that three hours in the forenoon, and three hours in the afternoon, is not a sufficient part of his time which ought to be appropriated for the superintendence of a school: Eight hours in a day (in the summer season) is the least portion of time for his attendance that can be truly called reasonable.

58. There are so many little, curious, and exact notions to engage the attention of a good and faithful Teacher, that he cannot dispense his several duties in less time than four hours. For in large schools he must superintend all the monitors, and teach them how to perform their several duties; in small schools, he must be principal Teacher and monitor himself: for although he can place a monitor

over every class, yet there is not always a sufficient variety of characters from which he can select a suitable number of disciplinarians.

59. A well regulated school *must* be overseen by the principal Teacher; he must *not* be above his business. He ought to superintend the cleaning and warming of the room,* see that the children come in regularly and decently, that their spare clothes are deposited in such manner, as not to create confusion by being mislaid, and, with a parental care, cause each child to have a fair opportunity for warming; he must see with the help of his monitors, that the implements are all in order for despatch of business: Pencils and penknives must be sharpened, pens mended, cards or lessons selected, slates and paper ruled, instructions given how to make and mend a pen, how to sit, hold the pen, and form letters systematically.†

60. A continual watch must be kept over the whole school by walking from class to class and teaching monitors and pupils in every part of the room: there is no time for sitting down indulgently: In short a good teacher must in the first place understand his business; secondly, have ample wages; and thirdly, earn his money, and become "worthy of his hire."

61. An objection will undoubtedly arise, that, "Children will injure their health and mental faculties by such close

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* If circumstances would permit to clean a school-room once in a week with a plentiful quantity of water, it would be a valuable preventive of diseases.

† Towne's copper-plate copies have exceeded all till of late; there is now an engraving of copies in Philadelphia which makes a very elegant impression.

attention to study;" but this is like many other traditional notions which are the bane of improvement, of prosperity, of an early advancement in science, and of the happiness of mankind. The minds of children are never wrought upon in such a love-sick and enthusiastic manner as to cause derangement, unless by bugbear frights. It is a confinement in the deleterious air which has become so contaminated by the respiration of the scholars, that the vital powers of the atmosphere are diminished. It is the desire children have for an object to which they are peculiarly inclined, *exercise*, that noble preventive of sickness, and preservative of health; and to the above desire another obstacle can be added, as, *unnecessary fear;* this is often produced by a morose and indiscreet Teacher, who practises after the old pernicious custom of feruling and lashing little helpless infants of six, eight, or ten years old. These are the hydra monsters that destroy the health of children, and not their intense study

62. GOVERNMENT OF A SCHOOL.

A School is not intended for a dungeon, a bastile, an inquisition, or an engine of torture; but a place of rudimental instruction and refined morals; a place to teach the tender minds by *example, moderation, forbearance, long-suffering, and kindness; bearing with the infirmities of the weak, &c. &c.*

63. There is no more necessity for whipping children in school, than for the Algerines to cut off a piece from the tongues of our American prisoners, when groaning under the burden of being driven in a team like horses.

64. In case large scholars become ungovernable, enjoin parents to take them home for a few days, and correct them as they think proper, by hard labour, by abstinence, or corporal punishment; and not suffer their youthful ambition to be annihilated by a public whipping in school, or their indignation raised to an ungovernable pitch against the Teacher. This injunction on parents should always be inserted and understood in the school-articles of agreement; and in case a temporary expulsion become necessary, a friendly, wise, and cautious consultation should be held between the Teacher and parents before the offender knows his destiny.

65. By this time a curious and scornful query may be proposed by some imperious character with the most sanguine assurance of confuting the above principles of humanity: "How is it possible for a Teacher to govern a school *without* whipping?" This question can be answered by asking another to the reverse: How can a Teacher govern a school *by* whipping? The experiment has been tried ever since English schools were instituted, and has universally failed; instead of good order, confusion has reigned predominant under the inauspicious government of all the whipping-masters contained in oral or written history.

Hatred, ill-will, revenge, inattention to study, and a dread of going to school, are concomitant evils that may be justly called, when collectively considered, the offspring of this injudicious custom.

66. This species of monarchical gentry introduce themselves as Teachers—an examination ensues—they must be proficients in reading, writing, arithmetic, and grammar:

School commences—a huge set of rods are prepared—the little sprightly Tyroes being not accustomed to confinement, violate orders;—the lash goes round and round, till some favourite hero, of larger growth or of more mature age, takes up the infant's cause: but, for want of strength, he first recurs to stratagem, counsels with his comrades; they then combine against the new admitted tyrant, and lay a plan whereby to gain revenge.

67. The sapient Teacher, conscious of his guilt, with jealous eye surveys each movement in the school.—He finds out part, and guesses at the rest.—Up comes poor James and John, with three or four more, to share the blessing of a scourge in school. Now this moral lasher, with redoubled fury, and fraught with dire revenge, unmindful of his prayers, his *catechisms*, or holy writ, pours forth his vengeance on the helpless youth!—Secrecy is then enjoined on all.—The term of teaching ends, and all rejoice to see the tyrant leave the school.

68. It is a rare sight to behold an established school, taught by one master, for any considerable series of time, where the old traditional impropriety of whipping is introduced.

69. This monstrous error of *school-whipping*, in contradiction of moral philosophy and common sense, has been committed by men of inadequate abilities, as to the superintendence of common schools, and has been even countenanced from the time of our forefathers' first settlement, to the present day—and frequently by men who make no scruple of inebriation; but daily sip the intoxicating draught, without the sense of fear or shame.

70. The *rod of correction* belongs to the province of parents and guardians, who, under the influence and teachings of nature, we might rationally suppose, would have more affection for children, than to transfer it to the hands of strangers: for, if through the impulse of passion parents do sometimes abuse their offspring, which in truth cannot be denied, what can they expect from strangers that are void of parental affection? From banished, disappointed, and almost profligate men, who never felt a glimpse of that maternal glow which softens anger into love.

71. In order thoroughly to impress on the minds of community, the baneful consequences of the foregoing *evil*, and cause them if possible to *abandon it* by adopting Lancaster's mode of distributing rewards, and by inflicting rational and mild punishments; I will request the reader to examine the regulations of colleges, of academies, and large seminaries in populous towns. I wish to ask if *these* institutions embrace that *martial*, that worse than *savage* punishment of whipping students into moral rectitude? Or in another instance, do the Ministers of the gospel, who have charge over a congregation, whip those parishioners, who are tenfold more obnoxious than their children?

72. Does not a knowing, mischievous, and designing offender, deserve a more severe punishment, than a child that merely acts from the impulse of a lively disposition? Yet in those institutions, lenient means and measures form the genius of their government.

73. It will not suffice to answer and say, that, "Policy dictates a more mild government, in managing overgrown offenders, than in managing children: that we can compel

little ones to submit to more tyrannical laws, than we can larger pupils." This is fostering the *erroneous principle* of which we complain; this is the deformed, the wicked, and the horrible act, that seals the *death warrant* of social and harmonious order throughout the whole intelligent part of animal creation. No, reader; humanity, morality, and the divine golden rule of "*doing unto others*," &c. must have a voice in these things.

74. In a republic like the United States, it may not be criminal to think and act on this subject: such a measure would not be treasonable; it would not be contrary to the genius of a majority of the people, nor an infringement on the constitution.*

75. *In the next place I will show how a School has been, now is, and most certainly in future will be, governed without Whipping.*†

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* It is contended by some eminent Teachers, that where boys are brought up in a city or populous town, and have no decent parents to govern them; a rod of suitable dimensions, used in a rational manner, is necessary. In such cases let the trustees employ teachers that can be relied on as to their discreetness in governing.

In obstinate cases, or when boys are guilty of wilful neglect, Mr. Wm. A. Tweed Dale, of the Lancastrian Academy, at Albany, has introduced the fashion of tapping the inside of the offender's hand or fingers with a small rod. The salutary effects arising from this mode of punishment, are superior to those of whipping: it is less degrading and at the same time sufficiently irksome; it tends to keep the passions of the Master within due bounds, and leaves the mind of the delinquent impressed with just treatment, without harbouring a secret idea of revenge.

† Joseph Lancaster of London who brought this plan of teaching to the present height of perfection, has more than one thousand scholars under his care in one school, and it is said, they are all governed without whipping.

76. In the first place let us attend to some general remarks, and secondly, mention particulars.

First, when a Teacher enters a school, he must take into consideration the conveniencies of the house, the season of the year, the natural and acquired abilities of the children, the manners, fashions, and dispositions of the employers generally, and all other objects appertaining to his important task.

77. The superintendence of different schools cannot be reduced to a particular form, like the declension of a noun or conjugation of a verb; nor will one set of rules always remain proper for the same school. Discretion must be exercised in varying the rules of government from time to time, as different circumstances may require: and that must be done without confusion, inconsistence, or perplexity.

78. If school-houses were built uniformly, in a suitable manner for the purpose intended, the management of a school might be reduced almost to a system.*

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* Though I expect no interest in the subject whatever, yet through pity to youth, who are yearly losing a great portion of their time by reason of inconvenient school-houses, will mention the size and formation suitable for one in the country: It ought to be forty-two feet by twenty-one, with chimnies (not stoves) at each end. The benches should not be fastened to the walls as in the usual way, but in two tiers crosswise of the house, with an aisle in the middle four feet wide lengthwise of the room. Then the benches may be about eight feet in length, with back spaces for the scholars to go in and out without disturbing each other. The outward door may be opposite one of the chimnies at a corner of the house, and an enclosure made for cleaning feet, &c. before coming into school. Another place on the opposite side of the chimney, may be for depositing dry wood for kindling morning fires. Then on each side of the other

But under the existing circumstances of our country schools, Teachers will be obliged to exercise their ingenuity with as many variations, as a good husbandman would his, in managing a farm.

79. A man well skilled in agriculture, will study out how to pursue the best modes throughout his various sorts of soil; the rich and moist will receive one series of culture during a suitable time, the steril and dry another; change of crops will be necessary for a third, while a fourth which has been mismanaged, but betokens signs of a fruitful field, will receive experiments by his philosophic care.

80. In other words, the care of a Teacher may be compared to that of a regular bred physician, who, free from nostrums and catholicons, observes every concurring circumstance of his patient, and administers accordingly; in difficult cases, performs his art with vigilance and closeness of application; so a Teacher, that determines to exhibit justice to his pupils and employers, and gain to himself good fame, must take into view all the accompanying requisites of those who are placed under his instruction.

81. In the second place we will enumerate particulars worthy the notice of a Teacher.

The reader may refer to clauses 60, 61, and 65—these three clauses point out several preparatory objects for the keeping of good order. In some cases, though not always, it is necessary that the Teacher should be first at school

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chimney, a closet and shelves may be formed as a receptacle for the loose clothes. Messrs. Enoch and Theodore Coburn, No. 14 Beaver-street, Albany, have made an improvement on the Russian stove.—It emits wholesome air, and is said to make a saving of about nine tenths in wood.

in the morning, and, having suitable wood prepared beforehand, build a fire very early, that the room may be warm, and not have confusion reign for want of a little timely preparation. When the scholars begin to enter the room, let the Teacher, or him whose turn it was to make a fire, receive the spare clothes from the children, and deposit them in such manner that he can expeditiously deliver them out again to the owners at noon.

Four times in a day some capable person must be placed as a steward to perform this duty with neatness and care.

Where the shelves are spacious, the depositing can be performed with ease; they may be numbered so as to correspond with the number of the classes, and the articles can be placed accordingly.*

82. It is now expected that the books, cards, pens, replenishing of the inkstands and utensils generally, have been seen to and prepared for the commencement of business. This preparation must be made on the preceding evening. The reason is obvious: For the Teacher must pay his whole attention to the order of the scholars; see that they come in decently with as little noise as possible, and not allow speaking to any one but the Teacher or Steward—see that fairness is used in warming, and order to their seats, classes or parts of a class when he judges proper.

83. In the next place some short appropriate devotional lesson may be read or otherwise performed, and business may begin with regularity, all attending to the different

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* In a school that is very numerous, the boys sling their hats in school-hours after the manner of slinging a knapsack; but placing them in holes under their writing-desks is more convenient.

branches designed for their tasks. Here it may be recollected that a monitor was previously taught and appointed over every class to superintend and instruct.* He will allow no whispering or speaking to any one but himself, and that on urgent business only.

84. Talking in school is considered by Lancaster as an offence. If a boy be guilty of this offence, the monitor will caution him against a repetition of it, and remind him in a discreet manner, that boys and girls who whisper, will be exposed to the whole school and disgraced, if they persist in disobeying rules and orders. When admonition will avail nothing in this or any other act of disobedience, the offender must have his name, and a description of his offence, conveyed to the Teacher; if the offender be of a senior class, he must be compelled to present the complaint himself.

85. The Teacher will then exercise his mind to find out some suitable punishment in proportion to the offence, having regard at the same time to the age and disposition of the delinquent. Among small children, merely a lecture from the Teacher, informing what will be done if they continue in wrong doing, generally answers the desired effect.

86. But among scholars of ten, twelve, or fourteen years of age, where a certain degree of hereditary arrogance begins to make its *show*, which too often originates from the influence of domestic dissatisfaction and bad examples; these moderate means will often prove ineffectual, and the offender must be dealt with according to demerit.

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* See clauses 4 and 5.

87. After admonition and persuasion fail in reclaiming, then a greater degree of severity must be used; place the transgressor on a block of about twelve inches square, in view of the whole school, and in such a situation that he must stand without leaning on any thing to afford ease—mark out a reasonable lesson—recite it to him several times distinctly.—When the delinquent has learned that lesson, and will read it with a proper emphasis and cadence, like a good scholar, let him go to his place.

88. Another offender may stand up in public view till he can deliver off a new lesson with a proper tone of voice, or give some pertinent explanation, &c. at his seat. A third can be employed in sweeping the house at noon, and be denied the pleasure of play.

89. When one grows so obstinate as to disregard these mild *restraints*, let severity increase—take Lancaster's mode as follows: "On a repeated or frequent offence, after admonition has failed, place a wooden log round the neck of the delinquent, which serves him as a pillory, and with this he is sent to his seat. This machine may weigh from four to six pounds, some more and some less. The neck is not pinched or closely confined—it is chiefly burdensome by the manner in which it incumbers the neck, when the delinquent turns to the right or left. While it rests on his shoulders, the equilibrium is preserved; but, on the least motion one way or the other, it is lost, and the log operates as a dead weight upon the neck. Thus, he is confined to sit in his proper position.

90. "If this is unavailing, it is common to fasten the legs of offenders together, with wooden shackles; one or

more, according to the offence. The *shackle* is a piece of wood about a foot, sometimes six or eight inches long, and tied to each leg. When shackled, he cannot walk but in a slow, measured pace; being obliged to take six steps, when confined, for two when at liberty. Thus accoutred, he is ordered to walk round the school-room, till tired out—he is glad to sue for liberty, and promise *his endeavour* to behave more steadily in future. Should not this punishment have the desired effect, the left hand is tied behind the back, or wooden shackles fastened from elbow to elbow, behind the back. Sometimes the legs are tied together.

91. "Frequent or old offenders are yoked together sometimes, by a piece of wood that fastens round all their necks: and thus confined, they parade the school; walking backwards, being obliged to pay very great attention to their footsteps, for fear of running against any object that might cause the yoke to hurt their necks, or to keep from falling down. Four or six can be yoked together this way."*

An effectual punishment may be imposed by "tying a bad boy to some fast object in the room after school-hours;" but this ought to be considered as an adequate punishment for some great offence.

92. The above specimens will show how to contrive a variety of other methods for punishing delinquents, as the nature of their crimes require. "These variations in the modes of *unavoidable punishment*," says Lancaster, "give it the continual force of novelty, whatever shape it may as-

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* This is however considered a dangerous method, where more than two are yoked together; and, they ought never to walk backwards.

sume. Any single kind of punishment, continued constantly in use, becomes familiar, and loses its effect. Nothing but variety can continue the power of novelty."

93. Here let the young or the inexperienced Teacher, make a pause—reflect—Will this or that act of punishment create any *savage cruelty* or *inquisitional torture*?[*] If so, stop—abandon the project, and exercise the mind anew.

94. The following ridiculous acts cannot be passed over without reprehensive notice, viz: Splitting a stick and fastening it to the tongue, nose, or lip—holding out a weight at arm's length—standing on one foot only—holding a brick which weighs four or five pounds—standing on a pin-block with the feet bare—shutting up a child in a dungeon, or laying it out in a coffin, &c. Some of these indiscreet acts, torment, and the others terrify, to an unreasonable and dangerous degree.

95. I shall not apologize for making the above remark, by saying, *in my opinion*, those acts are wrong, but will boldly ridicule them and all persons who countenance a repetition. Punishment ought to be in proportion to the crime, calculated in a manner that will humanize, and tend to self-conviction in the sufferer. In schools it ought to be contrived so that it will not hinder the delinquent in improving time, if the nature of the offence be trifling, and does not require severity.

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[*] The degeneracy of man, since the Christian and Apostolic era, is astonishingly great; especially among some of those who profess to be followers of Christ. In many parts of our world, the *gospel* stares its Ministers in the face, and *humanity* tinges the Lawgivers with a blush.

96. We will now take into view that impulse of the mind called *ambition*.

AMBITION in schools will work out a far greater good, than all the rods in the forest. We must exercise our best faculties in contriving to impress on the fancy of children, a pride in doing well, and reduce their reputation as little as possible in punishing for an offence; always holding out to their view the ill-appearance of disgrace, and the beauty of honour. Small presents given to little children will avail much; such as, chestnuts, walnuts, apples, pictures, and toys of many kinds; these cheap articles will create an earnestness in the little rogues to behave deserving of such agreeable presents. These presents must be given to deservers, to those who excel in good order, or in learning their tasks. If a fund be raised for this purpose, it will not amount to any thing grievous among the employers, and in one sense may be compared to loaning money at great interest.

97. EMULATION will be found a great auxiliary in governing; for when the mind is intent on duty, the body is generally free from mischief.

Each class may have numbers 1, 2, 3, 4, &c. to 12, printed on pasteboard and suspended from their button holes: classes in arithmetic, at stated times, may proceed in the manner of spelling classes as to precedence, and the one who excels or becomes head of the class, may have the honour to wear on his arm a badge, that is, a piece of leather about one and a half inch wide, and four or five inches long, gilt with the letters "MERIT IN ARITHMETIC," and filleted round the edges with gold leaf. This method may be practised also for reading and writing classes; or to reward a monitor for some extraordinary performance in his duties of teaching. The cost of lettering and gilding will be about one cent each badge.

98. Two classes, on a par of proficiency, may have a time appointed for trial in certain rules or lessons to see which class will outdo the other: that which gains the preference may have a prize, and sometimes a higher or more honourable seat.*

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* I will insert here a narration respecting one of Lancaster's judicious plans for reclaiming a number of disorderly boys. "As a further proof of the benefit resulting from this mode of instruction, the following instance is remarkable. Several boys belonging to my school, were in the habit of playing truant continually. This habit was contracted, as it usually is, by frequenting bad idle company. One boy seemed quite incorrigible: his father got a log and chain, chained it to his foot, and in that condition, beating him all the way, followed him to school repeatedly. Nothing was of any avail—neither was the lad reformed by any thing the parent could do. At last he was reformed by a contest about *an old rusty nail.* I am not fond of laying wagers; but, without any other design than the improvement of two classes, by raising a spirit of emulation among them, I betted with one of my subordinate monitors, a *shilling* against *an old rusty nail*, that another class would excel in writing on the slate, that in which he taught. In case it did, the old rusty nail was to be mine; and the oddity of the thing tickled the fancy of the boys, and served as well for the bone of contention as any thing else. Both classes being disposed to exert all their powers on the occasion, determined not to be excelled. I lost the wager in the sequel; but if it had been fifty times the value, it could not have had a better effect than it had. The truants I have been mentioning were in the two contending classes. The interest they took in the honour of their classes was so great, that instead of playing truant, they came to school, to aid their companions in securing the honour, which was more than the prize. The interest they took in the thing was so great, that they became pleased with school; and, above all, the almost incorrigible boy became reformed, and one of the best proficients in learning in the whole school; and for two years after, which he remained with me, no more was heard of his playing truant."

Let the trials be about once a week. This plan will keep the whole school striving from week to week. We will suppose that an appointment is made on the eighth day of the month, for two classes to strive for a prize on the fifteenth—on the eighth, show the prize, and inform each class, that, "this prize will be delivered to the monitor of that class which shall excel on the fifteenth;" and as an additional incitement for each individual of the classes, inform them likewise, that every scholar, in that class which shall excel, will be entitled to a cent each, to an honorary certificate, a picture, or something that will cause them all to feel a peculiar interest in the undertaking. Information may be given also, that, whoever becomes head in each class at the end of the first trial, shall be entitled to the privilege of aiding the monitors in preparing the classes for the second trial, and receive a prize in the same manner that the monitor shall have received it in the first. One, two, or more classes may have a trial on the same day, if the Teacher deem it expedient.

99. Prizes may be selected from a variety of such articles as please the fancy of children, having regard in the selection to something that is profitable or instructive; such as, penknives, cheap books, copperplate strips for copies, picture books, inkstands, apples, bright cents or half-cents, certificates of good behaviour, of excelling, of preferment, &c.

Toys, rows of pins, pinballs, pincushions, ribands, scissors, thimbles, maphandkerchiefs, abridgments of geography, &c. or other articles which the Teacher in his discretion may suppose most suitable.

A silk handkerchief, an elegant shawl or bonnet, may be presented to some female monitor, who, for a considerable time, has been very faithful in teaching; and be considered as no act of extravagance, more than to *reward the labourer according to his hire.*

100. Sometimes it may be profitable to vary the mode of trial above described, and permit two scholars of equal abilities, to make choice of fellow-students from such classes as they please; and from nearly the whole school, form two classes of respectable numbers; this method is commonly called *chusing sides;* but it tends to an inconvenience in preparing the classes for trial, because the parties are mixed, unless their stations at the benches are deranged at the time of chusing. It must be remembered moreover, that our good success greatly depends on the ambition and vigilance of the monitors. Therefore their conveniencies for teaching, are considered to be of consequence, and their rewards ought to be liberal.

Much more might be written on this subject if room would permit: I shall therefore refer the reader to those books mentioned in clause No. 1. But at the same time I cannot conscientiously omit mentioning one more gross evil, which, with a little energy, might be eradicated from country as well as from city schools; that is, *disturbance in the house before school hours, or at noon, or after school at evening.* A remedy is plain, easy, and practicable, even in the country where scholars are obliged to tarry at noon.

In the first place, let the trustees of the school be empowered to make rules and regulations—Let the employers be bound to aid in carrying those rules into effect; and, when a Teacher is hired, let the trustees put him under obligation to adhere to said rules. When circumstances are such that the school-house cannot be locked at noon, let the master appoint a discreet scholar as overseer till he returns—and any one refusing or neglecting to do his duty, shall be fined according to the judgment of the trustees. At evening the master may be the last that leaves the house and lock the same—In the morning the care of the school may be committed to him who builds the fire: and if the master be adequate to his task, he will be at school in season, and not give rogues any considerable time to display their mischievous talents.

END OF PART FIRST.

INTRODUCTION TO ARITHMETIC,

PART II.

CONTAINING

Cards No. 1, 2, 3, 4, 5,

SIMPLE ADDITION, SUBTRACTION, AND
MULTIPLICATION,

WITH

A SKETCH OF DECIMALS.

NOTE.—It is asserted by an able critic, that the ancient method of saying, “2 and 5 *are* 7, or 3 and 6 *are* 9,” &c. is not so elegant as to say, “2 and 5 *is* 7 or, 3 and 6 *is* 9,” and the like in other expressions of plurality. The grammatical reasons given are, “that the number 2, added to the number 3, is the number 5, or, the number 3, added to the number 6, is the number 9,” &c.

The Author has seen fit to express the numbers differently throughout the work, in order to have his mode of expression agree with that of Lancaster:—This note is inserted to give a hint to Teachers, and at the same time means that they may use either of the above methods, as their fancy may dictate.

Card No. 1. Formation

1 one 2 two 3 three 4 four
5 five 6 six 7 seven 8 eight
9 nine 10 ten 11 eleven
12 twelve 13 thirteen
14 fourteen 15 fifteen
16 sixteen 17 seventeen
18 eighteen 19 nineteen
20 twenty 21 twenty-one
22 twenty-two 23 twenty-three
24 twenty-four 25 twenty-five
26 twenty-six 27 twenty-seven
28 twenty-eight 29 twenty-nine
30 thirty 31 thirty-one
32 thirty two 33 thirty-three
34 thirty-four 35 thirty-five
36 thirty-six 37 thirty-seven

of Numbers.

38	thirty-eight	39	thirty-nine
40	forty	41	forty-one
42	forty-two	43	forty-three
44	forty-four	45	forty-five
46	forty-six	47	forty seven
48	forty-eight	49	forty-nine
50	fifty	51	fifty-one
52	fifty-two	53	fifty-three
54	fifty-four	55	fifty-five
56	fifty-six	57	fifty-seven
58	fifty-eight	59	fifty-nine
60	sixty	61	sixty-one
62	sixty-two	63	sixty-three
64	sixty-four	65	sixty-five
66	sixty-six	67	sitxy-seven
68	sixty-eight	69	sixty-nine

Card No. 2. Formation

70	seventy	71	seventy-one
72	seventy-two	73	seventy-three
74	seventy-four	75	seventy-five
76	seventy-six	77	seventy-seven
78	seventy-eight	79	seventy-nine
80	eighty	81	eighty-one
82	eighty-two	83	eighty-three
84	eighty-four	85	eighty-five
86	eighty-six	87	eighty-seven
88	eighty-eight	89	eighty-nine
90	ninety	91	ninety-one
92	ninety-two	93	ninety-three
94	ninety-four	95	ninety-five
96	ninety-six	97	ninety-seven
98	ninety-eight	99	ninety-nine
100	one hundred	101	one hundred and one

of Numbers.

108	One hundred and eight
109	one hundred and nine
110	one hundred and ten
111	one hundred and eleven
113	one hundred and thirteen
117	one hundred and seventeen
120	one hundred and twenty
201	two hundred and one
204	two hundred and four
209	two hundred and nine
302	three hundred and two
404	four hundred and four
406	four hundred and six
607	six hundred and seven
1001	one thousand and one
1002	one thousand and two

Combination of Numbers.

Two and 2 is 4, 3 and 1 is 4, 4 and 2 is 6, 5 and 1 is 6, 6 and 1 is 7, 3 and 2 is 5, 5 and 2 is 7, 6 and 2 is 8, 7 and 2 is 9, 8 and 2 is 10, 9 and 2 is 11, 10 and 2 is 12, 11 and 2 is 13, 12 and 2 is 14, 13 and 2 is 15, 14 and 2 is 16, 15 and 2 is 17, 16 and 2 is 18, 17 and 2 is 19, 18 and 2 is 20, 19 and 2 is 21, 4 and 3 is 7, 5 and 3 is 8, 6 and 3 is 9, 7 and 3 is 10, 8 and 3 is 11, 9 and 3 is 12, 10 and 3 is 13, 11 and 3 is 14, 12 and 3 is 15, 13 and 3 is 16, 14 and 3 is 17, 15 and 3 is 18, 26 and 3 is 29, 17 and 3 is 20.

Combination of Numbers.

18 and 3 is 21, 29 and 3 is 32, 5 and 4 is 9, 6 and 4 is 10, 7 and 5 is 12, 8 and 4 is 12, 9 and 4 is 13, 10 and 4 is 14, 12 and 3 is 15, 12 and 4 is 16, 13 and 4 is 17, 14 and 4 is 18, 15 and 4 is 19, 16 and 4 is 20, 27 and 5 is 32, 18 and 4 is 22, 29 and 4 is 33, 20 and 4 is 24, 21 and 4 25, 22 and 4 is 26, 23 and 4 is 27, 24 and 4 is 28, 29 and 4 is 33, 35 and 4 is 39, 43 and 4 is 47, 47 and 3 is 50, 55 and 3 is 58, 58 and 2 is 60, 62 and 3 is 65, 65 and 3 is 68, 68 and 2 is 70, 70 and 4 is 74, 74 and 5 is 79, 75 and 4 is 79, 80 and 7 is 87.

Combination of Numbers.

Nine and 1 is 10, and 1 is 11, and 1 is 12, and 2 is 14, and 2 is 16, and 2 is 18, and 2 is 20, and 2 is 22, and 2 is 24, and 2 is 26, and 2 is 28, and 2 is 30, and 2 is 32, and 2 is 34.

2 and 3 is 5, and 3 is 8, and 3 is 11, and 3 is 14, and 3 is 17, and 3 is 20, and 3 is 23, and 2 is 25, and 4 is 29, and 3 is 32, and 3 is 35, and 4 is 39, and 3 is 42, and 5 is 47, and 2 is 49.

9 and 3 is 12, and 3 is 15, and 3 is 18, and 3 is 21, and 4 is 25, and 2 is 27, and 3 is 30, and 1 is 31, and 5 is 36, and 4 is 40.

11 and 2 is 13, and 4 is 17, and 4 is 21, and 5 is 26, and 3 is 29, and 3 is 32, and 5 is 37, and 4 is 41, and 6 is 47, and 3 is 50.

Combination of Numbers.

4 and 6 is 10, and 4 is 14, and 5 is 19, and 2 is 21, and 5 is 26, and 3 is 29, and 3 is 32, and 4 is 36, and 4 is 40, and 9 is 49, and 4 is 53, and 4 is 57, and 4 is 61, and 9 is 70.

18 and 3 is 21, and 7 is 28, and 2 is 30, and 7 is 37, and 2 is 39, and 3 is 42, and 4 is 46, and 4 is 50, and 6 is 56, and 3 is 59, and 4 is 63, and 5 is 68, and 4 is 72, and 4 is 76.

37 and 3 is 40, and 6 is 46, and 3 is 49, and 4 is 53, and 4 is 57, and 4 is 61, and 6 is 67, and 5 is 72, and 6 is 78, and 3 is 81, and 2 is 83, and 1 is 84, and 5 is 89, and 2 is 91.

17 and 4 is 21, and 6 is 27, and 3 is 30, and 4 is 34, and 5 is 39.

Combination of Numbers.

Eleven and 6 is 17, and 7 is 24, and 5 is 29, and 4 is 33, and 4 is 37, and 5 is 42, and 3 is 45, and 4 is 49, and 6 is 55, and 6 is 61, and 7 is 68, and 2 is 70, and 6 is 76, and 3 is 79.

13 and 4 is 17, and 4 is 21, and 6 is 27, and 5 is 32, and 5 is 37, and 3 is 40, and 4 is 44, and 5 is 49, and 2 is 51, and 7 is 58, and 5 is 63, and 4 is 67, and 2 is 69, and 5 is 74.

8 and 7 is 15, and 4 is 19, and 5 is 24, and 3 is 27, and 4 is 31, and 9 is 40, and 1 is 41, and 7 is 48, and 5 is 53, and 6 is 59, and 5 is 64, and 3 is 67, and 4 is 71, and 5 is 76, and 5 is 81.

9 and 7 is 16, and 3 is 19, and 9 is 28, and 3 is 31, and 5 is 36.

Combination of Numbers.

5 and 7 is 12, and 5 is 17, and 6 is 23, and 4 is 27, and 5 is 32, and 7 is 39, and 5 is 44, and 4 is 48, and 5 is 53, and 5 is 58, and 3 is 61, and 7 is 68, and 2 is 70, and 5 is 75, and 8 is 83.

6 and 9 is 15, and 7 is 22, and 5 is 27, and 4 is 31, and 6 is 37, and 5 is 42, and 7 is 49, and 3 is 52, and 6 is 58, and 7 is 65, and 4 is 69, and 5 is 74, and 3 is 77, and 2 is 79, and 5 is 84.

7 and 6 is 13, and 4 is 17, and 3 is 20, and 3 is 23, and 7 is 30, and 8 is 38, and 7 is 45, and 4 is 49, and 5 is 54, and 8 is 62, and 5 is 67, and 4 is 71, and 8 is 79, and 7 is 86, and 5 is 91, and 7 is 98.

4 and 7 is 11, and 5 is 16, and 7 is 23, and 5 is 28, and 8 is 36.

KEY TO CARD No. 6.

SIMPLE ADDITION.

LESSON 1.

22 Apples.
34
21
33
12
23
—
145 Ap. in all.

Begin first by writing down in figures, twenty-two, thirty-four, twenty-one, thirty-three, twelve, twenty-three: Place them exactly one number under another as on the card.

Now begin at the first right hand 3, and say, 3 and 2 are 5, and 3 are 8, and 1 is 9, and 4 are 13, and 2 are 15; set down 5 and carry one; because there is once 10 in 15, and 5 over.

Then begin at the lower left hand 2, and say, 1 that I carry and 2 are 3, and 1 is 4, and 3 are 7, and 2 are 9, and 3 are twelve, and 2 are 14; set down 14 on the left side of the 5. Total in figures 145 apples—In words—One hundred and forty-five.

See clause 21, page 15—Also let each scholar write the sum total or answer in words as well as in figures.

Note.—To prove Addition, begin at top and reckon downward.

LESSON 2.

34 Peaches.
41
52
35
24
34
—
220 Peaches.

Write down on your slate 34, under that 41, then 52, 35, 24, 34:

Begin at the lowermost right hand 4, and say, 4 and 4 are 8, and 5 are 13, and 2 are 15, and 1 is 16, and 4 are 20: set down 0 under the 4, and carry 2; because there are twice 10 in 20.

KEY TO CARD No. 6.

Now begin at the lowermost 3, and say, 2 that I carry and 3 are 5, and 2 are 7, and 3 are 10, and 5 are 15, and 4 are 19, and 3 are 22. Set down 22 on the left side of the cipher.

Total in figures, 220 peaches. Write down in words Two hundred and twenty.

LESSON 3.

152 Pears.
343
444
561
324
444
———
2268 Prs. in all.

Place the figures on your slate as they are on the card. Then say, 4 and 4 are 8, and 1 is 9, and 4 are 13, and 3 are 16, and 2 are 18: set down 8 and carry 1.

One that I carry to 4 makes 5, and 2 are 7, and 6 are 13, and 4 are 17, and 4 are 21, and 5 are 26: set down 6 and carry 2.

Two that I carry to 4 are 6, and 3 are 9, and 5 are 14, and 4 are 18, and 3 are 21, and 1 is 22: set down 22 on the left side of 68. Total in figures 2268. In words, Two thousand two hundred and sixty-eight.

LESSON 4.

461 Apples.
352
433
502
434
346
———
2528

Begin at 6 and say, 6 and 4 are 10, and 2 are 12, and 3 are 15, and 2 are 17, and 1 is 18: set down 8 and carry 1.

One that I carry to 4 is 5, and 3 are 8, and 3 are 11, and 5 are 16, and 6 are 22: set down 2 and carry 2.

Two that I carry to 3 are 5, and 4 are 9, and 5 are 14, and 4 are 18, and 3 are 21, and 4 are 25: set down 25 on the left side of 28. Total in figures 2528. In words, Two thousand five hundred and twenty-eight Apples.

LESSON 5.

564 Peaches.
456
352
463
624
102
——
2561 Peaches in all.

Begin at the 2: 2 and 4 are 6, and 3 are 9, and 2 are 11, and 6 are 17, and 4 are 21: set down 1 and carry 2.

Second Column.

Two that I carry to 2 are 4, and 6 are 10, and 5 are 15, and 5 are 20, and 6 are 26: set down 6 and carry 2.

Third Column.

Two that I carry and 1 is 3, and 6 are 9, and 4 are 13, and 3 are 16, and 4 are 20, and 5 are 25: set down 25 on the left side of 61. Total in figures, 2561. In words, Two thousand five hundred and sixty one peaches."

N. B. The Numeration Table must be suspended in plain view, and copied on the slate occasionally. See Card No. 10.

LESSON 6.

1562 Pears.
2446
3125
4563
2344
4653
——
18693

First Column.

Three and 4 are 7, and 3 are 10, and 5 are 15, and 6 are 21, and 2 are 23: set down 3 and carry 2.

Second Column.

Two that I carry to 5 are 7, and 4 are 11, and 6 are 17, and 2 are 19, and 4 are 23, and 6 are 29: set down 9 and carry 2.

Third Column.

Two that I carry to 6, make 8, and 3 are 11, and 5 are 16,

KEY TO CARD No. 6.

and 1 makes 17, and 4 are 21, and 5 are 26: set down 6 and carry 2.

Fourth Column.

Two that I carry to 4 make 6, and 2 are 8, and 4 are 12, and 3 are 15, and 2 are 17, and 1 is 18: set down 18 on the left side of 693. Total in figures, 18693. In words, Eighteen thousand six hundred and ninety-three.

LESSON 7.

3470 Apples.
2665
4670
3760
0040
4000
———
18605

As the figures are all ciphers in the first column except a 5, set down 5 and begin with the second column, thus, 4 and 6 are 10 and 7 are 17 and 6 are 23, and 7 are 30: set down 0 and carry three, because there are three tens in 30.

Third Column.

Three that I carry and 7 are 10, and 6 are 16, and 6 are 22, and 4 are 26: set down 6 and carry 2.

Fourth Column.

Two that I carry to 4 are 6, and 3 are 9, and 4 are 13, and 2 are 15, and 3 are 18: set down 18 on the left side of 605. Total in figures, 18605. In words, Eighteen thousand six hundred and five.

LESSON 8.

6410 Peaches.
7520
4060
5007
7010
2200
———
32207

First Column.

Set down 7, because there is no other figure except ciphers.

Second Column.

One and 6 make 7, and 2 are 9, and 1 is 10: set down 0 and carry 1.

Third Column.

One that I carry to 2 makes 3, and 5 are 8, and 4 are 12: set down 2 and carry one.

KEY TO CARD No. 6.

Fourth Column.

One that I carry to 2 makes 3, and 7 are 10, and 5 are 15, and 4 are 19, and 7 are 26, and 6 are 32: set down 32. Total in figures 32207. In words, Thirty-two thousand two hundred and seven.

LESSON 9.

7420 Pears.
302
5008
710
4500
3300
———
21240

First Column.

8 and 2 are 10: set down 0 and carry one.

Second Column.

One that I carry and 1 make 2, and 2 are 4: set down 4 and carry nothing, because there are not ten in four.

Third Column.

Three and 5 are 8, and 7 are 15, and 3 are 18, and 4 are 22: set down 2 and carry 2.

Fourth Column.

Two that I carry to 3 are 5, and 4 are 9, and 5 are 14, and 7 are 21: set down 21. Total in figures 21240. In words, Twenty-one thousand two hundred and forty.

SIMPLE SUBTRACTION.

KEY TO CARD No. 6.

LESSON 1.

Borrowed 2468 dollars, and paid 1345; how much remains due? Answer, 1123 dollars.

DIRECTIONS HOW TO WORK.

Write down in figures 2468, and exactly under those figures write 1345 as you see them on the card.

KEY TO CARD No. 6.

2468 Bor.
1345 Paid.
———
1123 Due.

Begin with the 5 and say, 5 from 8 there remain 3: set down 3. Then 4 from 6 there remain 2: set down 2. Then 3 from 4 and 1 remains: set down 1. Then 1 from 2 and 1 remains: set down 1.

LESSON 2.

I wish to know the difference between 45621 and 35242.

Answer, 10379.

DIRECTIONS. *Look at the Card, Lesson* 2.

Set down 45621, and under that 35242.

45621
35242
———
10379 dif.

Begin with the 2 on the right and say, 2 from 1, I cannot; borrow 10 and say, 2 from 11 and 9 remain—carry the 10 that I borrowed but call it one; 1 to 4 makes 5—5 from 2, I cannot; borrow 10 and say, 5 from 12 and 7 remain—carry 1 to 2 makes 3—3 from 6 and 3 remain; 5 from 5 and 0 remains—3 from 4 and 1 remains.

LESSON 3.

582137 Dollars lent to the United States.
216232 Received back.
———
365905 Yet due.

OPERATE THUS.

Two from 7—5 remain—3 from 3—0 remains—2 from 1 I cannot take; borrow 10 and say, 2 from 11 and 9 remain—carry 1 to 6 is 7—7 from 2, I cannot; borrow 10 and say, 7 from 12 and 5 remain—carry 1 to 1 is 2—2 from 8 and 6 remain—2 from 5 and 3 remain.

The sum due is 365905. In words, Three hundred sixty-five thousand nine hundred and five.

KEY TO CARD No. 6.

LESSON 4.

456821 Dollars in the Bank.
324912 Received out.

131909 Dollars remain in the Bank.

Prepare your work on the slate like lesson 4, on the card. Now say, 2 from 1, I cannot; borrow 10 and say, 2 from 11—9 remain—carry 1 to 1 makes 2—2 from 2 and 0 remains—9 from 8, I cannot; borrow 10 and say, 9 from 18 and 9 remain—carry one to 4 makes 5—5 from 6 and 1 remains—2 from 5 and 3 remain—3 from 4 and 1 remains. Answer in figures, 131909. In words, One hundred and thirty-one thousand nine hundred and nine.

LESSON 5.

601021 Dollars sent to sea.
8970 Lost.

592051 On hand.

Prepare your work on the slate from card 6, *les.* 5.

Nothing from 1 and 1 remains—7 from 2, I cannot; borrow 10 and say, 7 from 12 and 5 remain—carry 1 to 9 is 10—10 from 0, I cannot; borrow 10 and say, 10 from 10 and 0 remains—carry 1 to 8 is 9—9 from 1, I cannot; borrow 10 and say, 9 from 11 and 2 remain—carry 1—1 from 0, I cannot; borrow 10 and say, 1 from 10 and 9 remain—carry 1—1 from 6 and 5 remain.

The sum remaining on hand is in figures 592051. In words, Five hundred and ninety-two thousand and fifty-one.

LESSON 6.

Received in, 821903 Dollars.
Paid out, 266232

On hand, 555671

Prepare the work.

KEY TO CARD No. 6.

Begin at the right hand 2 and say, 2 from 3 and 1 remains—3 from 10 and 7 remain—carry 1—1 to 2 makes 3—3 from 9—6 remain—6 from 11 and 5 remain—carry 1 to 6 is 7—7 from 12 and 5 remain—carry 1 to 2 makes 3—3 from 8 and 5 remain, Answer in figures 555671.

LESSON 7.

Received from Government, $781210
Expended in purchases, 521621

Remains on hand, 259589

One from 0, I cannot; but 1 from 10 and 9 remain; carry 1 to 2 makes 3—3 from 11 and 8 remain—carry 1 to 6 is 7—7 from 12 and 5 remain—carry 1 to 1 makes two—2 from 11 and 9 remain—carry 1 to 2 is 3—3 from 8 and 5 remain—5 from 7 and 2 remain.

Answer, in figures 259589. In words, Two hundred and fifty-nine thousand five hundred and eighty-nine.

PROOF BY ADDITION.

Add the two lower lines to make a total equal to the upper line; thus,

Second line, 521621
Third line, 259589

Like the first line, 781210 Proof.

LESSON 8.

If 641315 Soldiers enter Russia,
and 426436 are lost, how many return?

Ans. 214879 return.

Six from 5 I cannot; borrow 10, and say, 6 from 15, and 9 remain—carry 1 to 3 makes 4—4 from 11 and 7 remain—

KEY TO CARD No. 6.

carry 1 to 4 makes 5—5 from 13 and 8 remain—carry 1 to 6 makes 7—7 from 11 and 4 remain—carry 1 to 2 makes 3—3 from 4 and 1 remains—4 from 6 and 2 remain.

Answer in figures, 214879. In words, Two hundred and fourteen thousand eight hundred and seventy-nine.

LESSON 9.

What is the difference between 456781, and 326879?—Place the figures as on the card.

456781
326879
———
129902

Nine from 1, I cannot; borrow 10 and say, 9 from 11 and 2 remain—carry 1 to 7 makes 8—8 from 8, 0 remains—8 from 7 I cannot; borrow 10 and say, 8 from 17 and 9 remain—carry 1 to 6 makes 7—7 from 6, I cannot; borrow 10 and say 7 from 16 and 9 remain—carry 1 to 2 makes 3—3 from 5 and 2 remain—3 from 4 and 1 remains.

Difference in figures 129902. In words, One hundred and twenty-nine thousand nine hundred and two.

PROOF BY ADDITION.

Place the second line on your slate—Under that place the third line, then add,

Second line, 326879
Third line, 129902
———
Like unto the first line 456781 Proof.

LESSON 10.

If I have on hand 642137 Shingle nails, and use 472318, how many remain on hand?

KEY TO CARD No. 6.

Place your figures as in Lesson 10, on the card.

642137 Nails on hand,
472318 Made use of,
169819 Remain on hand.

Eight from 7, I cannot; borrow 10 and say, 8 from 17 and 9 remain—carry 1 to 1 makes 2—2 from 3 and 1 remains—3 from 1, I cannot; borrow 10 and say, 3 from 11 and 8 remain—carry 1 to 2 makes 3—3 from 2 I cannot; borrow 10 and say, 3 from 12 and 9 remain—carry 1 to 7 makes 8—8 from 4 I cannot; borrow 10 and say, 8 from 14 and 6 remain—carry 1 to 4 is 5—5 from 6 and 1 remains. Answer in figures, 169819. In words, One hundred and sixty-nine thousand eight hundred and nineteen.

PROOF BY ADDITION.

I made use of 472318 Nails,
Remain on hand 169819

Like the first line 642137 on hand before any were used.

LESSON 11.

Bought 460210 Awl blades,
Sold 340012 how many remain?

Answer, 120198

Two from 0, I cannot; borrow 10 and say, 2 from 10 and 8 remain—carry 1 to 1 makes 2—2 from 11 and 9 remain—carry 1 to 0 makes 1—1 from 2 and 1 remains—0 from 0 and 0 remains—4 from 6 and 2 remain—3 from 4 and 1 remains. Answer in figures, 120198. In words, One hundred and twenty thousand one hundred and ninety-eight.

N. B. Dollar characters are made thus $.

KEY TO CARD No. 6.

PROOF BY ADDITION.

Sold	340012
Remain unsold	120198
The number bought	460210 Proof.

Now let the learners omit their *phrases* in saying, " borrow *10*." They may mentally consider it without speaking aloud. See Lesson 12.

LESSON 12.

From 900000
Take 426436 how many remain?

Answer, 473564

Six from 10 and 4 remain—carry 1 to 3 is 4—4 from 10 and 6 remain—carry 1 to 4 is 5—5 from 10 and 5 remain—carry 1 to 6 is 7—7 from 10 and 3 remain—carry 1 to 2 is 3—3 from 10 and 7 remain—carry 1 to 4 is 5—5 from 9 and 4 remain.

Answer in figures, 473564. In words, Four hundred and seventy-three thousand five hundred and sixty-four.

LESSON 13.

$ 54321 Received, April 17th, 1815.
18765 Paid, May 1st, 1815, how many dollars remain due?

Ans. 35556 Remain due.

Five from 11 and 6 remain—carry 1 to 6 makes 7—7 from 12 and 5 remain—carry 1 to 7 is 8—8 from 13 and 5 remain—carry 1 to 8 is 9—9 from 14 and 5 remain—carry 1 to 1 is 2—2 from 5 and 3 remain.

Answer in figures, 35556. In words, Thirty-five thousand five hundred and fifty-six.

KEY TO CARD No. 6.

LESSON 14.

Borrowed 628134 Dollars.
Paid 419243 What remains due?

Answer, 208891 Dollars remain due.

Three from 4 and 1 remains—4 from 13 and 9 remain—carry 1 to 2 is 3—3 from 11 and 8 remain—carry 1 to 9 makes 10—10 from 18 and 8 remain—carry 1 to 1 makes 2—2 from 2—0 remains—4 from 6—2 remain.

Answer in figures, 208891. In words, Two hundred and eight thousand eight hundred and ninety-one.

LESSON 15.

Lent 644310 dollars. Received back 421536 dollars. I wish to know how many dollars are yet due?

The sum lent, 644310 dol.
Received, 421536

222774 due.

Six from 10 and 4 remain—carry 1 to 3 is 4—4 from 11 and 7 remain—carry 1 to 5 is 6—6 from 13 and 7 remain—carry 1 to 1 is 2—2 from 4 and 2 remain—2 from 4 and 2 remain—4 from 6 and 2 remain. Answer, 222774.

The Numeration Table must be attended to in the next place, and copied over and over repeatedly on the slates. The pupils must also be instructed in reading figures with precision and expertness. See card no. 7.

Note.—It is necessary to show the learners the analogy between Multiplication and Addition, as, 2 and 2 are 4, and 2 are 6, and 2 are 8, or 4 times 2 are 8, &c. And in Division, teach them that Subtraction will answer problems in that Rule.

SIMPLE MULTIPLICATION.

To the Teacher, but not for the learner till coming to Lesson 1*st.*

Now the Multiplication Table must be copied on the slates from Cards No. 8 and 9, and detached parts of it copied on pieces of paper for each one to look at occasionally—or the whole of the Tables may be hung round the room for daily inspection. After going over the lessons in simple Addition and Subtraction, and answering a few questions in Simple Multiplication, the learner may begin with Compound Addition of money.

The denominations of Federal Money however, are needless, except Dollars and Cents: These comprise the calculations of our business in the United States—they convey all our ideas respecting purchases, sales, and amounts. When fractional parts of a cent are to be reckoned in the price of several articles, Addition or Multiplication will show the amount as in whole numbers.

EXAMPLE 1.

Bo't 255 finished penknives, at 75.4* cents each; what is the amount? Answer, $192.27

OPERATION AS IN WHOLE NUMBERS.

```
  255 Penknives.
  75.4 Cents.
 ---------
  1020
 1275
1785
---------
192|27.0
```

By the rule of Decimals, "point off as many *fractional parts* from the product, as are contained in the *multiplicand* and *multiplier*"—the remainder on the left hand will be whole numbers. Therefore, point off the 0, on the right hand, and the numbers 19227, will be whole numbers or cents; then cut off two figures of the residue, and those on the left will be dollars.

---

* This number 75.4 must be read thus, "Seventy-five and four-tenths of a cent."

RULE TO BRING CENTS INTO DOLLARS.

Cut off the two right hand figures of any number of cents, and those on the left will be dollars.

Thus,	100 cents, or 1 dollar,	1|00
	120 cents, or 1 dollar and 20 cents,	1|20
	150 cents, or 1 dollar and 50 cents,	1|50
	550 cents, or 5 dollars and 50 cents,	5|50

EXAMPLE 2.

Bo't 250 Copy-books, at 24.75* cents each, what did they come to? Answer, $62.87½

OPERATION.

```
24.75  Cents.
  250  Copy-books.
---------
12375
4950
---------
61|87.50
```

Here I point off two figures for decimal parts, because there are two decimals in the multiplicand; —then the figures 6187, are whole numbers or cents. Cut off the two right hand figures, 87, and those on the left are dollars. The fractional parts 50 first pointed off, may be called, $\frac{50}{100}$, or $\frac{5}{10}$, or $\frac{1}{2}$, and when methodically inserted, they will stand thus, .50 or .5; and .5, equal ½ of any thing.

A little lecturing will soon show the learners how to value these fractional parts, and enable them to work United States currency, before they understand Decimals.†

---

* This number 24.75, must be read, "Twenty-four and seventy-five hundredths."

† The modern mode of naming Fractions, is to call Vulgar Fractions, *fractions*, and Decimal Fractions, *decimals;* but as books are printed differently we will not disagree about trifles: We will follow the usual method till the Teacher please to alter the phraseology.

.1 .2 .3 .4 .5 .6 .7 .8 .9 .25 .5 .75

$\frac{1}{10}$ $\frac{2}{10}$ $\frac{3}{10}$ $\frac{4}{10}$ $\frac{5}{10}$ $\frac{6}{10}$ $\frac{7}{10}$ $\frac{8}{10}$ $\frac{9}{10}$ $\frac{25}{100}$ or $\frac{1}{4}$; $\frac{1}{2}$ $\frac{75}{100}$ or $\frac{3}{4}$

These are of as small value as business will require; and if the parties in commerce, know what part of a cent they agree to in the price of one or more articles, they may, by the above method of Multiplication, or by Addition, calculate the amount to a degree of minuteness. Consequently, it is not requisite to trouble learners with a series of hard names; such as, "Ten mills make one cent; ten cents one dime; ten dimes one dollar; ten dollars one eagle," when one simple expression will answer every purpose intended, viz:

One hundred Cents make One Dollar.

KEY TO CARD No. 10.

LESSON 1.

In 123456 pair of shoes, how many shoes?
2 Shoes in a pair.

246912

Twice 6 are 12; set down 2 and carry 1—twice 5 are 10, and one I carried makes 11; set down 1 and carry one—twice 4 are 8, and one I carried is 9; set down 9—twice 3 are 6; set down 6; twice 2 are 4; set down 4; twice 1 is 2; set down 2.

Write down the answer in letters, Two hundred and forty-six thousand, nine hundred and twelve.

Those who cannot read their answers in figures, may lose their place and number as in spelling.

Proof of Lesson first by Short Division.
2)246912
123456

KEY TO CARD No. 10.

Say, 2 in 2, once; set down 1 under the 2. Two in 4, twice; set down 2 under the 4. Two in 6, three times; set down 3 under the 6. Two in 9 four times and 1 over; set down 4 under the 9—carry the 1 over, to the left side of the 1, makes 11. Two in 11 five times and one over; set down 5 under the 1, and carry the 1 over to the left side of the 2, makes 12. Two in 12, six times; set down 6 under the 2.

Write down in letters, One hundred and twenty-three thousand, four hundred and fifty-six.

LESSON 2.

In 654321 yards of three feet each, how many feet?

Answer, 1962963

OPERATION.

654321 Yards,
3 Feet in a yard,
———
1962963 Total, or Product in feet.

Three times 1 are 3—set down 3—3 times 2 are 6—set down 6—three times 3 are 9—set down 9—three times 4 are 12—set down 2 and carry 1—three times 5 are 15, and 1 that I carried makes 16—set down 6 and carry 1—three times 6 are 18, and 1 that I carried makes 19—set down 19. Answer in words, One million, nine hundred and sixty-two thousand, nine hundred and sixty-three.

PROOF BY DIVISION.

3)1962963 Divisor and Dividend.
654321 Quotient or proof.

Three in 19—6 times and 1 over—carry the 1 to 6 makes 16; three in 16—5 times and 1 over—carry the 1 to 2 makes 12—three in 12—4 times—three in 9—3 times—three in 6—2 times—three in 3—once; down with 1.

LESSON 3.

Multiplicand, 789 || In 789 Bushels how many pecks,
Multiplier, 4 || allowing four pecks to each bushel?
Product, 3156 Pecks.

Operation with words.

Four times 9 are 36; set down 6 and carry 3—4 times 8 are 32, and 3 I carried are 35; set down 5 and carry 3—4 times 7 are 28, and 3 I carried are 31; set down 31.

Answer in words, Three thousand, one hundred and fifty-six.

PROOF BY DIVISION.

4)3156
789 Proof of lesson 3.

Fours in 31—7 times and 3 over—carry 3 and prefix it to 5 makes 35—4 in 35—8 times and 3 over—carry 3 and prefix it to 6 makes 36—4 in 36—9 times.

LESSON 4.

In 987 five dollar bills, how many dollars?
5 dollars in each bill.
4935 Dollars—sum total, or product.

Five times 7 are 35; set down 5 and carry 3—5 times 8 are 40, and 3 that I carried are 43; 3 and carry 4—5 times 9 are 45, and 4 that I carried are 49—set down 49.

Answer in words, Four thousand nine hundred and thirty-five.

KEY TO CARD No. 10.

PROOF BY DIVISION.

5)4935

987 Quotient or Proof.

Five in 49—9 times and 4 over—5 in 43—8 times and 3 over—5 in 35—7 times.

KEY TO CARD No. 11.

LESSON 5.

In 246 fathom of 6 feet each, how many feet?

6

———

1476

Place the figures as on the card.

Begin under the 6 and say 6 times 6 are 36—6 and carry 3—6 times 4 are 24 and 3 I carried are 27—7 and carry 2—6 times 2 are 12 and 2 I carried are 14.

Answer in words, One thousand four hundred and seventy-six.

Proof of lesson fifth by Division.

6)1476

246

Six in 14—twice and 2 over; set down 2 and carry the 2 over to 7—6 in 27—4 times and 3 over—6 in 36—6 times.

LESSON 6.

In 400 weeks, how many days?

7

———

Ans. 2800 days.

Place 7, the number of days in a week, under the 4, and say, 7 times 4 are 28; set down 28, then bring down the two ciphers to the right hand of 28.

Answer in words, Two thousand eight hundred.

KEY TO CARD No. 11.

PROOF OF LESSON SIXTH BY DIVISION.

7)2800
400

Say 7 in 28—4 times—set down 4—7 in 0—0—in 0—0 —or

Begin and say, 7 in 28—4 times—set down 4 and place the two ciphers on the right hand side of the 4.

LESSON 7.

In 9460 dollars of 8 shillings each, how many shillings?
8

Ans. 75680 shillings.

Place the 8 under the 6, take no notice of the cipher till you have multiplied the figures: say 8 times 6 are 48; set down 8 and carry 4—8 times 4 are 32, and 4 that I carried are 36—6 and carry 3—8 times 9 are 72, and 3 I carried are 75: Now bring down the cipher on the right hand side of the 8.

Answer in words, Seventy-five thousand six hundred and eighty.

PROOF OF LESSON SEVENTH BY DIVISION.

8)75680
9460

Eight in 75—9 times and 3 over—carry the 3 to 6 makes 36—8 in 36—4 times and 4 over—4 on the left side of 8 will make 48—8 in 48—6 times—8 in 0 no times—set 0 on the right of 6.

KEY TO CARD No. 11.

LESSON 8.

In 20000 kegs, each containing 9 galls. how many galls.?
9

Ans. 180000 gallons.

Place 9 for a multiplier under the 2, and pay no regard to the ciphers at present: but say 9 times 2 are 18—set down 18 and place as many ciphers on the right of 18 as there are in the multiplicand.

Answer in words, One hundred and eighty thousand.

PROOF OF LESSON EIGHTH.

9)180000
20000

Say 9 in 18—2 times—set down 2 and bring down the ciphers on the right side of 2.

END OF PART SECOND.

INTRODUCTION TO ARITHMETIC,

PART III.

CONTAINING,

TABLES OF FOREIGN COINS, COMPOUND ADDITION,
A SKETCH OF DECIMALS, COMPOUND
SUBTRACTION,

AND AN

EXPLANATION OF CARD No. 16.

TABLES OF WEIGHT AND VALUE.

In addition to Card No. 12, the following Table of weight and value of Coins in the United States, is inserted for the teacher or reader.

N. B. *dwt. or pwt. stands for Pennyweight: gr. Grain.*

dwt.	*gr.*			*Cents.*
4	8	of copper make a Half-Cent or,		.5
8	16	of copper make 1 Cent, or		1.
17	7	of silver make 1 Dollar, or		100.
18	17	do. make 1 Crown, or		110.
	27	of British or Portuguese gold	=	100.
	$27\frac{2}{3}$	of French or Spanish gold	=	100.
4	6	A Spanish Pistole	=	377.3
4	4	A French Pistole	=	366.7
5	6	An English Guinea	=	466.7
5	6	A French Guinea	=	459.8
6	22	A Moidore	=	614.8
9		A Single Johannes	=	800.
18		A Double Johannes	=	1600.

The reader will recollect the rule for cutting off the two right hand figures, to make dollars on the left. See p. 82.

FEDERAL VALUE OF SILVER.

		Cents.
The Pennsylvania Fi'penny bit, or New-York Sixpence	=	6.25
A Half Pistareen	=	10.
A Dime	=	10.
One eighth of a Dollar, or New-York Shilling	=	12.5
A Pistareen	=	20.
An English Shilling	=	22.2
A Quarter of a Dollar	=	25.
A Half Dollar	=	50.
A Dollar	=	100.
A Crown	=	110.

OF GOLD.

A Quarter of an Eagle,	=	250.
A Half Eagle,	=	500.
An Eagle is 10 Dollars, or		1000.

By a statement of eminent Teachers, we have information of other foreign Coins valued as follows:

	Cents.
The Pound Sterling,	444.44
of Ireland,	410.25
Pagoda of India,	194.
Tale of China,	148.
Mill-ree of Portugal,	124.
Ruble of Russia,	66.
Rupee of Bengal,	55.5
The Guilder of the United Netherlands,	39.
Mark Banco of Hamburg,	33.5
Livre Tournois of France,	18.5
Real Plate of Spain,	10.

COMPOUND ADDITION.

MONEY.

Place pounds under pounds, shillings under shillings, pence under pence, and farthings under farthings.

Carry at every four in the farthings, at every twelve in the pence, at every twenty in the shillings, and at every ten in the pounds.

When adding farthings, divide their sum total by 4, set the *remainder* in place of farthings, and carry the *quotient* to the pence.

When adding pence, divide their sum total by 12, set the *remainder* in place of pence, and carry the *quotient* to the shillings.

When adding shillings, divide their sum total by 20, set the *remainder* in place of shillings, and carry the *quotient* to the pounds.

KEY TO CARD No. 13.

LESSON 1.

£.	*s.*	*d.*
72	13	4
89	16	3
21	17	4
32	1	8
61	6	3
£277	14	10

Place the figures regularly on your slates as represented by the card. Then begin at the lowermost 3 in the column of Pence, and say, 3 and 8 are 11, and 4 are 15, and 3 are 18, and 4 are 22; how many times 12 in 22? once, and 10 over; set down 10, and carry 1 to the shillings.

Shillings.

One that I carry to 6 makes 7, and 1 is 8, and 17 are 25, and 16 are 41, and 13 are 54; how many times 20 in 54? twice, and 14 over; set down 14, and carry 2 to the pounds.

Pounds, first column.

Two that I carry and 1 makes 3, and 2 are 5, and 1 is 6, and 9 are 15, and 2 are 17—7 and carry 1.

KEY TO CARD No. 13.

Pounds, second column.

One that I carry to 6 makes 7, and 3 are 10, and 2 are 12, and 8 are 20, and 7 are 27—set down 27. Answer in words, Two hundred and seventy-seven pounds fourteen shillings and ten pence.

Prove addition by beginning at the top, and reckoning downwards.

LESSON 2.

£.	*s.*	*d.*	*q.*
81	19	4	1
46	7	3	2
31	18	9	3
171	11	5	2
320	10	6	2
£ 652	7	5	2

Begin with farthings and say, 2 and 2 are 4, and 3 are 7, and 2 are 9, and 1 is 10; how many times 4 in 10? twice, and 2 over; set down 2, and carry 2 to the pence.

Pence.

Two that I carry to 6 make 8, and 5 are 13, and 9 are 22, and 3 are 25, and 4 are 29; how many times 12 in 29?—2 times and 5 over: set down 5, and carry 2 to the shillings.

Shillings.

Two to 10 are 12, and 11 are 23, and 18 are 41, and 7 are 48, and 19 are 67; how many times 20 in 67?—3 times, and 7 over; set down 7, and carry 3 to the pounds.

Pounds, first column.

Three to 1 is 4, and 1 is five, and 6 are 11, and 1 is 12—2 and carry 1.

Pounds, second column.

One that I carry to 2 is 3, and 7 are 10, and 3 are 13, and 4 are 17, and 8 are 25—5 and carry 2.

Pounds, third column.

Two that I carry to 3 is 5, and 1 is 6; set down 6.

Answer in words, Six hundred and fifty-two pounds, seven shillings and five pence half-penny.

KEY TO CARD No. 13.

LECTURE.

Why do we divide farthings by 4? Because 4 farthings make 1 penny; and whatever number of pennies or pence there are, must be added in the pence column.

Why do we divide pence by 12? Because 12 pence make one shilling; and whatever number of shillings there are, must be added in the column of shillings.

Why do we divide shillings by 20? Because 20 shillings make one pound; and whatever number of pounds there are, must be added to the pounds.

Let the Teacher or a senior Monitor lecture the classes in this way or with other pertinent observations when occasion shall require.

We will now endeavour to manage the shillings by a more easy method.

RULE.

Carry the half to the pounds, that is, divide the hundreds and tens by 2; carry the quotient to the pounds: if any remainder happen, it will always be a 1, set that 1 in the place of tens, on the left side of the units of shillings.

EXAMPLE.

54 shillings. 2)54
£ 2 14

Here I say, 2 in 5—2 times and 1 over; sét the 1 by the 4, makes 14 shillings, and the 2, being the quotient, goes to the place of pounds.

LESSON 3.

£ 158	4	3	0
209	6	4	2
48	10	7	1
61	8	9	3
100	9	11	3
100	0	0	0
£ 678	0	0	1

Farthings.

Three and 3 are 6, and 1 is 7, and 2 are 9—4 in 9, twice and 1 over; set down 1 and carry 2 to the pence.

KEY TO CARD No. 13.

Pence.

Two that I carry to 11 are 13, and 9 are 22, and 7 are 29, and 4 are 33, and 3 are 36—12 in 36—3 times, and nothing over; set down 0, and carry 3 to the shillings.

Shillings.

Three that I carry to 9 are 12, and 8 are 20, and 10 are 30, and 6 are 36, and 4 are 40—the half of 4 is 2; set down 0 and carry 2 to the pounds.

Pounds, first column.

Two that I carry to 1 make 3, and 8 are 11, and 9 are 20, and 8 are 28; set down 8 and carry 2.

Pounds, second column.

Two that I carry to 6 are 8, and 4 are 12, and 5 are 17—set down 7 and carry 1.

Pounds, third column.

One I carry to 1 is 2, and 1 is 3, and 2 are 5, and one is 6; set down 6.

Answer in words, Six hundred and seventy-eight pounds one farthing.

LESSON 4.

£.	*s.*	*d.*	*q.*
21	6	0	0
54	13	0	0
62	15	0	0
35	4	2	0
178	17	3	0
55	19	7	1
£ 408	15	0	1

In the place of farthings, set down 1, there being no more in the column of farthings.

Pence.

Seven and 3 are 10, and 2 are 12; set down 0 and carry 1 to the shillings.

Shillings.

Now take the most easy mode to reckon the shillings—go up with the units first, then count the tens downward.

One that I carry to 9 makes 10, and 7 are 17, and 4 are 21, and 5 are 26, and 3 are 29, and 6 are 35, and 10 are

KEY TO CARD No. 13.

45, and 10 are 55, and 10 are 65, and 10 are 75; the half of 7 is 3, and 1 over; set the 1 on the left side of the 5 in the place of shillings, which will make 15 shillings, and carry the 3 to the pounds.

Pounds, first column.

Three that I carry to 5 make 8, and 8 are 16, and 5 are 21, and 2 are 23, and 4 are 27, and 1 is 28—8 and carry 2.

Pounds, second column.

Two that I carry to 5 make 7, and 7 are 14, and 3 are 17, and 6 are 23, and 5 are 28, and 2 are 30; 0, and carry 3 to the third column;—3 that I carry, and 1, makes 4.

Sum total in words, Four hundred and eight pounds, fifteen shillings and one farthing.

LESSON 5.

A Merchant's Memorandum.

Broadcloth,	£ 548	14	6
Coating,	361	16	4
Chints,	249	3	7
Calico,	185	14	6
Total,	£ 1345	8	11

Pence.

Six and 7 are 13, and 4 are 17, and 6 are 23; how many times 12 in 23? 1 time and 11 over; set down 11, and carry 1 to the shillings.

Shillings.

One to 4 makes 5, and 3 are 8, and 6 are 14, and 4 are 18, and 10 are 28, and 10 are 38, and 10 are 48; the half of 4, is 2; set down 8, and carry 2 to the pounds.

Pounds, first column.

Two that I carry to 5 are 7, and 9 are 16, and 1 is 17, and 8 are 25—5 and carry 2.

Pounds, second column.

Two I carry to 8 make 10, and 4 are 14, and 6 are 20, and 4 are 24—4 and carry 2.

KEY TO CARD No. 13.

Pounds, third column.

Two I carry, and 1 makes 3, and 2 are 5, and 3 are 8, and 5 are 13; set down 13.

Total in words, One thousand three hundred and forty-five pounds, eight shillings and eleven pence.

LESSON 6.

A Bill of articles bought of a merchant.

4 Yards of Fustian at	4*s.* 6*d.*	£0	18	0	0
9 do. of Velvet,	9*s.* 4¼*d.*	4	4	2	1
16 Pounds of Nails,	1*s.* 2*d.*	0	18	8	0
5 Gallons of Wine,	12*s.* 4*d.*	3	1	8	0
4 Bushels of Salt,	7*s.* 5*d.*	1	9	8	0
6 Pounds of Coffee,	2*s.*	0	12	0	0
3 do. Hyson Tea,	9*s.* 3*d*,	1	7	9	0
Amount,		£12	11	11	1

As there is only one farthing in the column of farthings, set down 1, and begin with the

Pence.

Nine and 8 are 17, and 8 are 25, and 8 are 33, and 2 are 35; how many times 12 in 35?—2 times and 11 over; set down 11, and carry 2 to the shillings.

Shillings.

Two that I carry to 7 are 9, and 2 are 11, and 9 are 20, and 1 is 21, and 8 are 29, and 4 are 33, and 8 are 41, and 10 are 51, and 10 are 61, and 10 are 71; the half of 7 is 3 and 1 over; set 1 by the left side of the other 1, makes 11, and carry 3 to the pounds.

Pounds.

Three I carry, and 1 is 4, and 1 is 5, and 3 are 8, and 4 are 12; set 12 for pounds.

Amount in words, Twelve pounds, eleven shillings, and eleven pence one farthing.

KEY TO CARD No. 13.

LESSON 7.

A Farmer's Bill.

Sold	10 fat Oxen, at	£ 18 12*s.*	=	£ 186	0	0	0
	4 Calves,	45*s.*		9	0	0	0
	15 Sheep,	17*s.* 6*d.*		13	2	6	0
	12 Store hogs,	25*s.* 3*d.*		15	3	0	0
	4 fat Swine,	135*s.* 5*d.*		27	1	8	0
	33 bushels of Oats,	2*s.*		3	6	0	0
	25 do. Rye,	6*s.* 5*d.*		8	0	5	0
	Amount,			£ 261	13	7	0

As there are no farthings, begin with the

Pence.

Five and 8 are 13, and 6 are 19; how many times 12 in 19? once 12 in 19, and 7 over; set down 7 and carry 1 to the shillings.

Shillings.

One I carry to 6 is 7, and 1 is 8, and 3 are 11, and 2 are 13—this number being under 20, or less than 20, set down 13.

Pounds.

Eight and 3 are 11, and 7 are 18, and 5 are 23, and 3 are 26, and 9 are 35, and 6 are 41—1 and carry 4.

Pounds, second column.

Four I carry to 2 are 6, and 1 is 7, and 1 is 8, and 8 are 16—6 and carry 1.

One I carry to 1, in the third column, makes 2; set down 2.

Amount in words, Two hundred and sixty-one pounds, thirteen shillings and seven pence.

KEY TO CARD No. 14.

LESSON 8.

A Shipper's Memorandum.

	£.	s.	d.	q.
Paid for House Insurance,	784	13	9	0
Ship Washington, do.	867	14	2	0
Duties on the cargo,	962	13	8	0
Wharfage,	42	11	3	0
Repairs,	250	17	11	0
A balance due for goods,	946	10	4	1
Amount,	£3855	1	1	1

Set 1 in the place of farthings, and proceed to the

Pence.

Four and 11 are 15, and 3 are 18, and 8 are 26, and 2 are 28, and 9 are 37; how many times 12 in 37? 3 times and 1 over; set down 1, and carry 3 to the shillings.

Shillings.

Three I carry to 7 are 10, and 1 is 11, and 3 are 14, and 4 are 18, and 3 are 21, and 10 are 31, and 10 are 41, and 10 are 51, and 10 are 61, and 10 are 71, and 10 are 81; the half of 8 is 4; set down the 1, and carry 4 to the pounds.

Pounds, first column.

Four I carry to 6 are 10, and 2 are 12, and 2 are 14, and 7 are 21, and 4 are 25—5 and carry 2.

Pounds, second column.

Two I carry to 4 are 6, and 5 are 11, and 4 are 15, and 6 are 21, and 6 are 27, and 8 are 35—5 and carry 3.

Pounds, third column.

Three I carry and 9 are 12, and 2 are 14, and 9 are 23, and 8 are 31, and 7 are 38; set down 38.

Amount in words, Three thousand eight hundred and fifty-five pounds, one shilling, one penny, and one farthing,

KEY TO CARD No. 14.

FEDERAL MONEY.

One hundred Cents make One Dollar.

LESSON 9.

Write down in figures, Lesson 9, as you see it on the Card, excepting the lower line.

That is, write as I read, and look at the card for a pattern.

Seven hundred eighty-six cents, one tenth of a cent*—— Four hundred sixty-nine cents, two tenths——Three hundred forty-one cents, three tenths——Seven hundred eighty-four cents, four tenths——Eight hundred seventy-seven cents, five tenths——Four hundred eighty-six cents, six tenths——Six hundred twenty-one cents, seven tenths.

Now add in the same manner you add whole numbers :— Carry for every ten.

First column.

Seven and 6 are 13, and 5 are 18, and 4 are 22, and 3 are 25, and 2 are 27, and 1 is 28; set down 8 under the tenths and carry 2—make a period on the left side of 8— This is called eight tenth parts of a cent.

Second column.

Two I carry and 1 is 3, and 6 are 9, and 7 are 16, and 4 are 20, and 1 is 21, and 9 are 30, and 6 are 36—6 and carry 3.

Third column.

Three I carry and 2 are 5, and 8 are 13, and 7 are 20, and 8 are 28, and 4 are 32, and 6 are 38, and 8 are 46—6 and carry 4.

Fourth column.

Four I carry to 6 are 10, and 4 are 14, and 8 are 22, and 7 are 29, and 3 are 32, and 4 are 36, and 7 are 43; set down 43.

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* Place a *period* between the cents and tenths of cents. This *period* is called units in Decimals; it is used to separate whole numbers from decimals. We will know more respecting this subject in a few days.

KEY TO CARD No. 14.

Begin at the period and count two figures to the left; cut these two figures off with a fine perpendicular stroke— Those on the left are dollars, and the two cut off to the right are cents.

Sum total in words, Forty-three dollars, sixty-six cents, and eight tenths of a cent; or, Four thousand, three hundred and sixty-six cents, eight tenths.

LESSON 10.

Cents.
4 8 6 .8
6 4 2 .9
3 6 4 .5
4 6 8 .7 5*
6 4 2 .6
5 4 4 .4
6 8 1 .3

3 8|3 1 .2 5

Set down 5 at the right hand of tenths; then begin with 3 tenths.

Three and 4 are 7, and 6 are 13, and 7 are 20, and 5 are 25, and 9 are 34, and 8 are 42; set down 2, make a period on the left side of it, and carry 4 to the whole numbers.

First column of whole numbers.

Four I carry, and 1 is 5, and 4 are 9, and 2 are 11, and 8 are 19, and 4 are 23, and 2 are 25, and 6 are 31;—1 and carry 3.

Second column of whole numbers.

Three I carry, and 8 are 11, and 4 are 15, and 4 are 19, and 6 are 25, and 6 are 31, and 4 are 35, and 8 are 43;—3 and carry 4.

Third column of whole numbers.

Four I carry, and 6 are 10, and 5 are 15, and 6 are 21, and 4 are 25, and 3 are 28, and 6 are 34, and 4 are 38; set down 38.

Sum total in words. Three thousand eight hundred and thirty-one cents, and twenty-five hundredths of a cent: or, cut off the two right hand figures of whole numbers, and those on the left will be dollars. See the card.

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* See pages 81, 82.

KEY TO CARD No. 14.

LESSON 11.

Cents.
8 6 7 .2 5
5 4 9 .5
6 7 2 .7 5
8 4 4 .2 5
6 5 4 .5
4 6 1 .5
7 6 2 .
4 8|1 1 .7 5

First column.

Five and 5 are 10, and 5 are 15: set down 5 and carry 1.

Second column.

One I carry to 5 is 6, and 5 are 11, and 2 are 13, and 7 are 20, and 5 are 25, and 2 are 27; set down 7, make your period, and carry 2 to the next.

Third column.

Two I carry to 2 are 4, and 1 is 5, and 4 are 9, and 4 are 13, and 2 are 15, and 9 are 24, and 7 are 31—1 and carry 3.

Fourth Column.

Three I carry to 6 make 9, and 6 are 15, and 5 are 20, and 4 are 24, and 7 are 31, and 4 are 35, and 6 are 41; 1 and carry 4.

Fifth Column.

Four I carry to 7 are 11, and 4 are 15, and 6 are 21, and 8 are 29, and 6 are 35, and 5 are 40, and 8 are 48; set down 48.

Sum total in words, Four thousand eight hundred and eleven cents, and seventy-five hundredths of a cent.

Cut off the two right hand figures of any number of cents—those on the left will be dollars.

LESSON 12.

Cents.
1 3 4 1 .2
2 4 6 1 .2
1 4 6 0 .1
0 3 4 8 .5
0 2 1 9 .0
0 4 0 0 .0
4 9 1 6 .0
1 1 1|4 6 .

First Column.

Five and 1 is 6, and 2 are 8, and 2 are 10; set down nought and carry 1.

Second Column.

One I carry to 6 makes 7, and 9 are 16, and 8 are 24, and 1 is 25, and 1 is 26—6 and carry 2.

Third Column.

Two I carry to 1 make 3, and 1 is 4, and 4

KEY TO CARD No. 14.

are 8, and 6 are 14, and 6 are 20, and 4 are 24—4 and carry 2.

Fourth Column.

Two I carry and 9 are 11, and 4 are 15, and 2 are 17, and 3 are 20, and 4 are 24, and 4 are 28, and 3 are 31—1 and carry 3.

Fifth Column.

Three I carry and 4 are 7, and 1 is 8, and 2 are 10, and 1 is 11; set down 11.

Sum total in words, Eleven thousand one hundred and forty-six cents; or, One hundred and eleven dollars and forty-six cents.

LESSON 13.

Cents.
701.
4809.25
45.
64.
201.5
8600.
14420.75
28841.5

First Column.

Five and 5 are 10; set down nought, that is, nothing, but carry 1 to the next.

Second Column.

One I carry to 7 is 8, and 5 are 13, and 2 are 15; set down 5 and carry 1.

Third Column.

One I carry to 1 is 2, and 4 are 6 and 5 are 11 and 9 are 20 and 1 is 21—1 and carry 2.

Fourth Column.

Two I carry and 2 are 4, and 6 are 10, and 4 are 14—4 and carry 1.

Fifth Column.

One I carry and 4 are 5, and 6 are 11, and 2 are 13, and 8 are 21, and 7 are 28—8 and carry 2.

Sixth Column.

Two I carry and 4 are 6, and 8 are 14, and 4 are 18—8 and carry 1 to the 1 in the seventh column, makes 2; set down 2.

KEY TO CARD No. 14.

Sum total in words, Twenty-eight thousand eight hundred and forty-one cents, and five tenths of a cent.

LESSON 14.

A Farmer's Memorandum.

			Dollars.
Bought	1 Farm,		3450.
	100 Turnpike shares,	at $ 25.	2500.
	15 Lottery Tickets,	8.	120.
	4 Yoke of Oxen,	72.	288.
	3 Horses,	64.	192.
	150 Sheep,	1.375	206.25
	57 Shares in Bank,	20,	1140.
	Amount of the Memorandum,		$ 7896.25

Set down 25 in the place of cents, and begin with the dollars.

First Column.

Six and 2 are 8, and 8 are 16—6 and carry 1.

Second Column.

One I carry to 4 makes 5, and 9 are 14, and 8 are 22, and 2 are 24, and 5 are 29—9 and carry 2.

Third Column.

Two I carry to 1 is 3, and 2 are 5, and 1 is 6, and 2 are 8, and 1 is 9, and 5 are 14, and 4 are 18—8 and carry 1.

Fourth Column.

One I carry and 1 is 2, and 2 are 4, and 3 are 7; set down 7.

Amount of the memorandum in words, Seven thousand eight hundred and ninety-six dollars and twenty-five hundredths of a dollar.

N. B. .25 hundredths, equal one quarter—.5 tenths, equal one half—.75 hundredths, equal three quarters.

Show or teach the class how to write the above note on the slates.

COMPOUND SUBTRACTION.

KEY TO CARD No. 15.

LESSON 1.

Borrowed,	£ 782	14	6	1
Paid,	691	11	3	2
Due,	£ . 91	3	2	3

Begin with the 3 farthings and say, 2 from one I cannot—borrow 4 and add to the 1, makes 5; now say, 2 from 5 and 3 remain; set down 3 and carry 1 to the pence.

Pence.

One I borrowed and 3 make 4—4 from 6 and 2 remain; set down 2: and because I did not borrow, I will not carry any to the shillings.

Shillings.

11 from 14, and 3 remain; set down 3.

Pounds.

One from 2, and 1 remains; set down 1—9 from 8 I cannot; borrow 10 and add to 8 makes 18—9 from 18, and 9 remain; set down 9 and carry 1—one I borrowed I carry to 6 makes 7—7 from 7, and nought remains—place a period . under the 6.

The sum due in words, Ninety-one pounds, three shillings and two pence, three farthings.

LESSON 2.

Borrowed,	£ 664	17	3	2
Paid,	375	18	4	3
Remains due,	£ 288	18	10	3

Begin with the 3 in the farthings and say, 3 from 2 I cannot; borrow 4 and add to the 2 makes 6—3 from 6 and 3 remain; set down 3 and carry 1 to the pence.

Pence.

One I carry to 4 is 5—5 from 3 I cannot; borrow 12—

KEY TO CARD No. 15.

12 and 3 are 15—5 from 15, and 10 remain; set down 10, and carry 1 to the shillings.

Shillings.

One I carry to 18 is 19—19 from 17 I cannot; borrow 20 and add to 17, makes 37—19 from 37, and 18 remain; set down 18 and carry one to the pounds.

Pounds.

One I carry to 5 makes 6—6 from 4 I cannot; borrow 10, and say, 6 from 14 and 8 remain; set down 8 and carry 1.

One I carry to 7 is 8—8 from 6 I cannot; borrow 10 and say, 8 from 16, and 8 remain; set down 8 and carry 1.

One I carry to 3 is 4—4 from 6 and 2 remain; set down 2.

Remains due in words, the sum of, Two hundred and eighty-eight pounds, eighteen shillings, and ten pence, three farthings.

LESSON 3.

Lent,	£ 361	16	3	2
Received,	48	16	4	1
Due,	£ 312	19	11	1

Now proceed in a different mode of subtracting.

Farthings.

1 from 2 and 1 remains; set down 1.

Pence.

Four from 3 I cannot, but from 12 and 8 remain—8 and 3 are 11; set down 11 and carry 1 to the shillings.

Shillings.

One I carry to 16 makes 17—17 from 16 I cannot, but 17 from 20 and 3 remain—3 and 16 are 19; set 19 in the shillings, and carry 1 to the pounds.

Pounds.

One to 8 makes 9—9 from 11 and 2 remain; carry 1 to 4 is 5—5 from 6 and 1 remains—nothing from 3 and 3 remains.

KEY TO CARD No. 15.

Answer in words, Three hundred and twelve pounds, nineteen shillings, eleven pence, and one farthing.

LESSON 4.

From the sum of	£ 1000	0	0	0
Take	145	11	0	2
The difference is	£ . 854	8	11	2

Farthings.

Two from cipher I cannot, but 2 from 4, the number of farthings in a penny, and 2 remain—set down 2 and carry 1, because I borrowed 4 farthings equal to 1 penny.

Pence.

One I carry to cipher makes one—1 from 0, I cannot; borrow 12, the number of pence in a shilling, and say, 1 from 12 and 11 remain—set down 11 and carry 1.

Shillings.

One I borrowed and 11 makes 12—12 from 0, I cannot; borrow 20, the number of shillings in a pound, and say, 12 from 20 and 8 remain—set down 8 and carry 1.

Pounds.

One I borrowed, to 5, is 6—6 from 0, I cannot; borrow 10 and say, 6 from 10 and 4 remain; set down 4 and carry 1.

One I carry to 4 is 5—5 from 0, I cannot; borrow 10 and say, 5 from 10 and 5 remain—set down 5 and carry 1.

One I carry to 1 is 2—2 from 10, and 8 remain; set down 8.

The difference in words is, Eight hundred and fifty-four pounds, eight shillings, and eleven pence, half-penny.

LESSON 5.

Dollars.	*Cents.*
84668—	25.5
33768—	75.7
50899—	49.8

Seven from 5 I cannot, but 7 from 15 and 8 remain; set down 8 with a period on the left side, and carry 1 to the next.

One I carry to 5 is 6—6 from 5 I cannot, but 6 from 15 and 9 remain; set down 9 and carry 1.

KEY TO CARD No. 15.

One to 7 is 8—8 from 2 I cannot, but 8 from 12 and 4 remain; set down 4 and carry 1.

One I carry to 8 is 9—9 from 8 I cannot, but 9 from 18 and 9 remain; set down 9 and carry 1.

One I carry to 6 is 7—7 from 6 I cannot, but 7 from 16 and 9 remain; set down 9 and carry 1.

One I carry to 7 is 8—8 from 6 I cannot, but 8 from 16 and 8 remain; set down 8 and carry 1.

One I carry to 3 is 4—4 from 4 and 0 remains—set down 0—3 from 8 and 5 remain; set down 5.

The difference in words is, Fifty thousand eight hundred and ninety-nine dollars, forty-nine cents and eight tenths of a cent.

LESSON 6.

Dollars. Cents,
From 87654–37.5
Take 33654–75.

The difference is 53999–62.5

Nought from 5 and 5 remain; set down 5—5 from 7 and 2 remain; set down 2.

Seven from 3 I cannot, but 7 from 13 and 6 remain—set down 6 and carry 1.

One I carry to 4 is 5—5 from 4 I cannot, but 5 from 14 and 9 remain—set down 9 and carry 1.

One I carry to 5 is 6—6 from 5 I cannot, but 6 from 15 and 9 remain—set down 9 and carry 1.

One I carry to 6 is 7—7 from 6 I cannot, but 7 from 16 and 9 remain—set down 9 and carry 1.

One I carry to 3 is 4—4 from 7 and 3 remain; set down 3.

Three from 8 and 5 remain—set down 5.

The difference in words is, Fifty-three thousand, nine hundred and ninety-nine dollars, sixty-two cents, and five tenths of a cent.

KEY TO CARD No. 15.

LESSON 7.

Memorandum.

Received 8th May, 1815, the several following sums:

	Dollars. Cents.
From Government,	221855–25.
From New-York,	378650–37.5
From Pennsylvania,	183210–50.
From Baltimore,	134765–75.
Amounting to	918481–87.5
Paid out in manner as follows:	
To the Surgeon General,	312750–48.5
To American Invalids,	156375–24.25
To British Invalids,	156375–24.25
Paid out in all,	$ 625500–97.00

What sum remains on hand?

First take the several sums received—add them on your slates—then add the sums paid out.

Begin with the sums received—set down .5 tenths; make your period.

Now begin with the second column.

Five and 7 are 12, and 5 are 17; set down 7 and carry 1.

Third column.

One I carry to 7 is 8, and 5 are 13, and 3 are 16, and 2 are 18—8 and carry 1.

Fourth column.

One I carry to 5 makes 6, and 5 are 11—set down 1 and carry 1.

Fifth column.

One I carry to 6 makes 7, and 1 is 8, and five are 13, and 5 are 18—8 and carry 1.

Sixth column.

One I carry to 7 is 8, and 2 are 10, and 6 are 16, and 8 are 24—set down 4 and carry 2.

KEY TO CARD No. 15.

Seventh column.

Two I carry to 4 are 6, and 3 are 9, and eight are 17, and 1 is 18—8 and carry 1.

Eighth column.

One I carry to 3 is 4, and 8 are 12, and 7 are 19, and 2 are 21—1 and carry 2.

Ninth column.

Two I carry and 1 is 3, and 1 is 4, and 3 are 7, and 2 are 9—set down 9.

Amount of money received, Nine hundred and eighteen thousand, four hundred and eighty-one dollars, eighty-seven cents and five tenths of a cent.

Now add the money paid out.

First column.

Five and 5 are 10—0 and carry 1.

Second column.

One I carry to 2 is 3, and 2 are 5, and 5 are 10—set down 0 with a period and carry 1.

Third column.

One I carry to 4 is 5, and 4 are 9, and 8 are 17—7 and carry 1.

Fourth column.

One I carry to 2 is 3, and 2 are 5, and 4 are 9; set down 9 and carry nothing.

Fifth column.

Five and 5 are 10—0 and carry 1.

Sixth column.

One I carry to 7 is 8, and 7 are 15, and 5 are 20—set down 0 and carry 2.

Seventh column.

Two I carry to 3 are 5, and 3 are 8, and 7 are 15—set down 5 and carry 1.

Eighth column.

One I carry to 6 is 7, and 6 are 13, and 2 are 15—set down 5 and carry 1.

KEY TO CARD No. 15.

Ninth column.

One I carry and 5 makes 6, and 5 are 11, and 1 is 12—set down 2 and carry 1.

Tenth column.

One I carry to 1 is 2, and 1 is 3, and 3 are 6—set down 6.

Amount of money paid out, Six hundred and twenty-five thousand five hundred dollars, ninety-seven cents.

Money received,	$ 918481–87.5
Money paid out,	$ 625500–97.
Remains on hand,	$ 292980–90.5

Take the sum paid out from the sum received.

Say nothing from 5 and 5 remain—set down five in the tenth's place of cents, with a period.

Seven from 7 and 0 remains.

Nine from 8 I cannot; borrow 10, and add to the 8, will make 18; take 9 from 18, and 9 remain—set down 9, and carry 1 for the 10 borrowed.

One I carry to 0 is 1—1 from 1, and 0 remains—set down 0.

Nought from 8, and 8 remain—set down 8.

Take 5 from 4 I cannot; borrow 10 will make it 14, take 5 from 14, and 9 remain; set down 9, and carry 1.

One I carry to 5 is 6, take 6 from 8, and 2 remain; set down 2.

Take 2 from 1, I cannot; borrow 10 and add to the 1, makes 11; take 2 from 11, and 9 remain; set down 9, and carry 1 for the 10 borrowed.

One I carry to 6 is 7; take 7 from 9 and 2 remain; set down 2.

Answer in figures, $ 292980–90.5—In words, Two hundred and ninety-two thousand, nine hundred and eighty dollars, ninety cents, and five tenths of a cent.

ADDITION.

5	and	3	are	8
5	and	6	are	11
5	and	4	are	9
5	and	8	are	13
6	and	7	are	13
8	and	3	are	11
7	and	5	are	12
9	and	4	are	13
10	and	6	are	16
11	and	7	are	18
9	and	6	are	15
5	and	11	are	16
12	and	7	are	19
13	and	5	are	18
15	and	9	are	24
13	and	7	are	20
14	and	6	are	20
14	and	9	are	23
17	and	8	are	25
16	and	5	are	21
15	and	8	are	23
19	and	9	are	28

SUBTRACTION.

3	from	8,	remain	5
6	from	11,	remain	5
4	from	9,	remain	5
8	from	13,	remain	5
7	from	13,	remain	6
3	from	11,	remain	8
5	from	12,	remain	7
4	from	13,	remain	9
6	from	16,	remain	10
7	from	18,	remain	11
6	from	15,	remain	9
11	from	16,	remain	5
7	from	19,	remain	12
5	from	18,	remain	13
9	from	24,	remain	15
7	from	20,	remain	13
6	from	20,	remain	14
9	from	23,	remain	14
8	from	25,	remain	17
5	from	21,	remain	16
8	from	23,	remain	15
9	from	28,	remain	19

MULTIPLICATION.

Twice		12	are	24	8	times	9	are	72
3	times	12	are	36	8	times	5	are	40
6	times	7	are	42	8	times	8	are	64
6	times	9	are	54	8	times	12	are	96
7	times	8	are	56	8	times	4	are	32
7	times	9	are	63	10	times	12	are	120
5	times	3	are	15	11	times	7	are	77
5	times	7	are	35	11	times	5	are	55
5	times	9	are	45	10	times	11	are	110
4	times	12	are	48	12	times	11	are	132
4	times	11	are	44	11	times	11	are	121

DIVISION.

3	in	15,	5	times	9	in	72,	8	times
5	in	40,	8	times	11	in	44,	4	times
5	in	55,	11	times	11	in	110,	10	times
7	in	42,	6	times	11	in	132,	12	times
7	in	35,	5	times	11	in	121,	11	times
7	in	77,	11	times	4	in	32,	8	times
8	in	56,	7	times	12	in	24,	2	times
8	in	64,	8	times	12	in	36,	3	times
9	in	54,	6	times	12	in	48,	4	times
9	in	63,	7	times	12	in	96,	8	times
9	in	45,	5	times	12	in	120,	10	times

The monitor will form questions from the foregoing key in the following manner.

ADDITION.

How many are 19 and 9? How many are 15 and 8? How many are 16 and 5?

SUBTRACTION.

Nine from 28, how many remain? 8 from 23, how many remain?

MULTIPLICATION.

How many are 11 times 11? How many are 12 times 11?

DIVISION.

How many times 11 in 121? He must begin with the head of the class, and proceed as in spelling: For instance, No. 1, How many are 19 and 9? If he answer right, let him retain his place; if not, let the first boy that answers the question correctly, have precedence.

NOTE.—I begin at the bottom of the page, because there the numbers will form more difficult questions than those at the top, and generally the best scholars are near the head of the class.

I do this to encourage those toward the foot of the class, who are not so forward as others: For if a boy can answer and say, 5 and 3 make 8, he will be better pleased than to answer with a negative shake of the head. This partiality, however, is not allowable when striving for a prize.

END OF PART THIRD.

INTRODUCTION TO ARITHMETIC,

PART IV.

CONTAINING,

COMPOUND MULTIPLICATION.

COMPOUND MULTIPLICATION.

KEY TO CARD No. 17.

LESSON 1.

If 1 yoke of oxen, cost	£ 32	16	8	2
what will 2 yoke cost?				2
Answer,	£ 65	13	5	0

OPERATION IN WORDS.

Begin with the farthings, and say, twice 2 are 4—4 farthings make one penny; set down 0 and carry the 1 penny to the pence.

Pence.

Twice 8 are 16, and one I carried makes 17—17 pence make one shilling and five pence; set down 5 and carry 1 to the shillings.

Shillings.

Twice 6 are 12, and one I carried are 13; set down 3 in units' place of shillings, and carry 1; then say, twice 1 is 2, and one I carried is 3—the half of 3 is 1, and 1 over—set the 1 over on the left side of the 3, and carry the half to the pounds.

Pounds.

Twice 2 are 4, and one I carried makes 5; set down 5.

Twice 3 are 6—set down 6.

Answer in words, Sixty-five pounds, thirteen shillings, and five pence.

KEY TO CARD No. 17.

PROOF OF LESSON FIRST BY DIVISION.

Write down in figures,	2)65	13	5	0
	32	16	8	2

Prepare your work as you see it on the Card, under proof of Lesson 1.

Then say, how many times 2 in 6?—3 times; set down 3 and say, how many times 2 in 5?—twice and 1 over; set down 2 on the right hand side of the 3, and call the 1 over, 1 pound, which makes 20 shillings to carry to the shillings.

Shillings.

Twenty shillings I carry from the pounds to 13 make 33 shillings—how many times 2 in 33?—16 times and 1 over; set down 16.

Pence.

One over I carry from the shillings makes 12 pence, and 5 pence are 17; how many times 2 in 17?—8 times and 1 over; set down 8 and carry the 1 to the farthings.

Farthings.

One penny over I carry makes 4 farthings, how many times 2 in 4?—twice; set down 2.

Proof in words, Thirty-two pounds, sixteen shillings, and eight pence, halfpenny.

LESSON 2.

	£	s.	d.	qrs.
If 1 yard of cloth cost	£ 2	5	6	1
what sum will 3 yds. cost?				3
Answer,	£ 6	16	6	3

Farthings.

Three times 1 makes 3; set down 3.

Pence.

Three times 6 are 18—18 pence make 1 shilling and 6 pence; set down the 6 pence, and carry the 1 shilling.

Shillings.

Three times 5 are 15, and one I carry makes 16; set down 16 shillings.

KEY TO CARD No. 17.

Pounds.

Three times 2 are 6; set down 6 pounds.

Answer in words, Six pounds, sixteen shillings, and six pence, three farthings.

PROOF OF LESSON 2.

Write in figures £6 16 6 3, place a 3 before pounds as on the card.

3)6 16 6 3
2 5 6 1

Pounds.

How many times 3 in 6? 2 and nothing over; set down 2.

Shillings.

How many times 3 in 16?—5 times, and 1 over I carry to the pence.

Pence.

One shilling over I carried, makes 12 pence, and 6 are 18; how many times 3 in 18?—6 times; set down 6.

Farthings.

How many times 3 in 3? once; set down 1.

Proof in words, Two pounds five shillings, and six pence farthing.

LESSON 3.

If one load of wheat, cost £16 16 11 2, what will [illegible] loads cost? 4

Answer, £67 7 10 0

Farthings.

Four times 2 are 8—8 farthings make 2 pence; set down 0 and carry 2 to the pence.

Pence.

Four times 11 are 44, and 2 I carried make 46—46 pence are 3 shillings and 10 pence; set down 10, and carry 3 to the shillings.

Shillings.

Four times 6 are 24, and 3 I carried are 27—set 7 in the units of shillings and carry 2—4 times 1 is 4, and 2 I carried are 6, the half of 6 is 3, carry 3 to the pounds.

Pounds.

Four times 6 are 24, and 3 I carried are 27—set down 7 and carry 2.

Four times 1 are 4, and 2 I carried are 6.

Answer in words, Sixty-seven pounds, seven shillings and ten pence.

PROOF OF LESSON 3.

4)67 7 10 0 *Prepare your work as on*
16 16 11 2 *the Card.*

Pounds.

Four in 6 once, and 2 over; set down 1 and carry the 2 to the left side of the 7, makes 27—4 in 27—6 times and 3 over I carry to the shillings—set down 6.

Shillings.

Three pounds over I carried, make 60 shillings, and 7 make 67—how many times 4 in 67?—say 4 in 6—once and 2 over—4 in 27—6 and 3 over; by this you find 16 times 4 in 67, and 3 over; set down 16 and carry 3 to the pence.

Pence.

Three shillings over I carried, make 36 pence, and 10 make 46; how many times 4 in 46?—11 times and 2 over—set down 11, and carry 2 to the farthings.

Farthings.

Two pence over I carried, make 8 farthings; how many times 4 in 8?—twice; set down 2 and the work is done.

Proof in words, Sixteen pounds sixteen shillings and eleven pence half-penny.

LESSON 4.

Bought 5 waggons at £24 17 4 3 each, what did the whole cost? 5

Answer, £124 6 11 3

Farthings.

Five times 3 are 15—15 farthings, are 3 pence and 3

KEY TO CARD No. 17.

farthings over; set down 3 and carry the 3 pence to the pence.

Pence.

Five times 4 are 20 and 3 I carried are 23—23 pence are 1 shilling and 11 pence; set down 11 and carry 1 to the shillings.

Shillings.

Five times 7 are 35, and one I carried is 36; set down 6 and carry 3—5 times 1 is 5, and 3 I carried are 8, the half of 8 is 4, which I carry to the pounds.

Pounds.

Five times 4 are 20, and 4 I carried are 24; set down 4 and carry 2—5 times 2 are 10, and 2 I carried are 12; set down 12.

Answer in words, One hundred and twenty-four pounds, six shillings and eleven pence three farthings.

PROOF OF LESSON 4.

Prepare your work. 5)124 6 11 3

24 17 4 3

Pounds.

Five in 12—twice and 2 over; set down 2 and carry 2 to the left side of the 4, makes 24—5 in 24—4 times and 4 over; set down 4 and carry 4 to the shillings.

Shillings.

Four pounds over I carried make 80 shillings, and 6 make 86: how many times 5 in 86?—say 5 in 8—1 and 3 over—5 in 36—7 times and 1 over; here you find 17 times 5 in 86 and 1 over—set down 17, and carry the 1 to the pence.

Pence.

One shilling over I carried makes 12 pence, and 11 make 23—5 in 23—4 times and 3 over; set down 4 and carry 3 to the farthings.

Farthings.

Three I carried from the pence make 12 farthings, and 3 are 15; how many times 5 in 15? 3 times; set down 3.

KEY TO CARD No. 17.

Proof in words, Twenty-four pounds seventeen shillings and four pence three farthings.

LESSON 5.

When I hire a man at £ 0 . 7 . 11 . 1 a day, what sum will his hire amount to in 6 days.

6

£ 2 . 7 . 7 . 2

Farthings.

Six times 1 is 6—6 farthings make 1 penny 2 farthings; set down 2 and carry 1 to the pence.

Pence.

Six times 11 are 66, and one I carried are 67—67 pence are 5 shillings and 7 pence; set down 7 and carry 5 to the shillings.

Shillings.

Six times 7 are 42, and 5 I carried are 47—47 shillings, make 2 pounds 7 shillings; set down 7 and carry 2 to the pounds.

Answer in words, Two pounds seven shillings and seven pence half-penny.

PROOF OF LESSON 5.

6)2 . 7 . 7 . 2

7 . 11 . 1

Pounds.

Six in 2 I cannot—carry the 2 to the shillings.

Shillings.

Two pounds I carried make 40 shillings, and 7 are 47—6 in 47—7 times, and 5 over I carry to the pence.

Pence.

Five shillings over I carried make 60 pence, and 7 make 67; how many times 6 in 67?—11 times and 1 over I carry to the farthings; set down 11.

Farthings.

One penny over I carried, makes 4 farthings, and 2 are 6; how many times 6 in 6?—once; set down 1.

KEY TO CARD No. 17.

LESSON 6.

Bought 7 yards of broadcloth at £2 7 8 1 a yard, what is the amount? 7

Answer. £16 13 9 3

Farthings.

Seven times 1 is 7—7 farthings make 1 penny 3 farthings; set down 3 and carry 1 to the pence.

Pence.

Seven times 8 are 56 and one I carried makes 57—57 pence make 4 shillings and 9 pence; set down 9 and carry [illegible] the shillings.

Shillings.

Seven times 7 are 49 and 4 I carried are 53—53s. make [illegible] pounds 13 shillings; set down 13 and carry 2 to the [illegible]

Pounds.

[illegible] ven [illegible] are 1[illegible] and 2 I carried are 16; set down 16. [illegible] wer [illegible] teen pounds thirteen shillings and [illegible] ce three farthings.

[illegible] OF LESSON 6.

7)16 [illegible] 3 *Pounds.*

[illegible] 7 8 [illegible] How many times 7 in 16? twice, [illegible] over; set down 2 and carry 2 to the shillings.

Shillings.

Two that I carried from the pounds make 40 shillings, [illegible] make 53—how many times 7 in 53? 7 times, and 4 [illegible] set down [illegible] and carry 4 to the pence.

Pence.

[illegible] shillings over I carried make 48 pence, and 9 are [illegible] how many times 7 in 57? 8 times, and 1 over; set [illegible] 8 and carry 1 to the farthings.

Farthings.

[illegible] penny over I carried makes 4 farthings, and 3 are [illegible] how many times 7 in 7? once; set down 1.

KEY TO CARD No. 17.

Proof in words, Two pounds seven shillings and eight pence, farthing.

LESSON 7.

If 1 load of sole leather cost £ 80 14 6 2
what will 8 loads cost? 8

Answer, £ 645 16 4 0

Farthings.

Eight times 2 are 16—16 farthings, make 4 pence; set down 0, and carry 4 to the pence.

Pence.

Eight times 6 are 48, and 4 that I carried are 52—52 pence make 4 shillings and 4 pence; set down the 4 pence, and carry the 4 shillings to the shillings.

Shillings.

Eight times 4 are 32, and 4 I carried are 36—6 and carry 3—8 times 1 is 8, and 3 are 11; the half of 11 is 5 and 1 over; set the 1 on the left of 6, and carry the 5 to the pounds.

Pounds.

Eight times 0 is 0, and 5 I carried are 5; set down 5 and carry nothing.

Eight times 8 are 64; set down 64.

Answer in words, Six hundred and forty-five pounds sixteen shillings and four pence.

PROOF OF LESSON SEVENTH.

8)645 16 4 0
80 14 6 2

How many times 8 can I have in 64? 8 times; set down 8 under the 4.

How many times 8 in 5? 0 times; set down 0 under the 5, and carry the 5 to the shillings.

Shillings.

Five pounds I carried, make 100 shillings, and 16 make 116; how many times 8 in 116? Place 116 in a memorandum on some part of your slate, and say, 8 in 11—once;

KEY TO CARD No. 17.

set down 1, then 3 over place by 6, will make 36—8 in 36—4 times, and 4 over to carry to the pence; thus you find 14 times 8 in 116, and 4 over.

Pence.

Four shillings I carried, make 48 pence, and 4 make 52; how many times 8 in 52? 6 times and 4 over; set down 6 and carry 4 to the farthings.

Farthings.

Four pence I carried, make 16 farthings—8 in 16—twice; set down 2.

Proof in words, Eighty pounds, fourteen shillings, and six pence, half-penny.

LESSON 8.

What will 9 days' masoning cost at £0 10 4 2
per day? 9

Answer, £4 13 4 2

Farthings.

Nine times 2 are 18—18 farthings make 4 pence 2 farthings; set down 2, and carry 4 to the pence.

Pence.

Nine times 4 are 36, and 4 I carried are 40—40 pence are 3 shillings and 4 pence; set down 4 and carry 3 to the shillings.

Shillings.

Nine times 10 are 90, and 3 I carry are 93—93 shillings make 4 pounds, 13 shillings; set down 13 in the place of shillings, and 4 in the place of pounds.

Answer in words, Four pounds thirteen shillings and four pence half-penny.

Proof of lesson eighth.

9)4 13 4 2
10 4 2

Here I cannot have 9 in 4, but I say, 4 pounds make 80 shillings, and 13 make 93: then I say, how many times 9

KEY TO CARD No. 17.

in 93? 10 times, and 3 over; set down 10 in the place of shillings, and carry 3 to the pence.

Pence.

Three shillings I carried, make 36 pence, and 4 make 40—how many times 9 in 40? 4 times and 4 over; set 4 in the place of pence, and carry 4 to the farthings.

Farthings.

Four pence I carried, make 16 farthings, and 2 are 18—how many times 9 in 18? twice; set down 2, in the place of farthings.

KEY TO CARD No. 18.

LESSON 9.

When wheat is sold at £0 14 4 2 a bushel, what must I pay for 10 bushels?

£0 14 4 2
10
£7 3 9 0

Farthings.

Ten times 2 are 20—20 farthings make 5 pence; set down 0 and carry 5 to the pence.

Pence.

Ten times 4 are 40, and 5 I carried are 45—45 pence are 3 shillings and 9 pence; set down 9, and carry 3 to the shillings.

Shillings.

Ten times 4 are 40, and 3 I carried are 43; set down 3 and carry 4—10 times 1 is 10 and 4 are 14—the half of 14 is 7—carry 7 to the pounds.

Pounds.

Ten times 0 is 0, but 7 I carried make 7; set down 7.

Answer in words, Seven pounds three shillings and nine pence.

PROOF OF LESSON 9.

10)7 3 9 0
14 4 2

Ten in 7 I cannot, but 7 pounds will make 140 shillings, and 3 will make 143—how many times 10 in 143? 14 times, and 3 over; set down 14, and carry 3 to the pence.

KEY TO CARD No. 18.

Pence.

Three shillings over that I carried, make 36 pence, and 9 are 45—how many times 10 in 45? 4 times; set down 4, and 5 over I carry to the farthings.

Farthings.

Five pence I carried make 20 farthings—how many times 10 in 20? twice; set down 2.

LESSON 10.

If the cost of clearing 1 acre of land, amount to
£6 17 3 3 what will 11 acres cost?
11

£75 10 5 1

Farthings.

Eleven times 3 are 33—33 farthings are 8 pence 1 farthing; set down 1 and carry 8 to the pence.

Pence.

Eleven times 3 are 33, and 8 I carried are 41—41 pence make 3 shillings and 5 pence; set down 5 and carry 3 to the shillings.

Shillings.

Eleven times 7 are 77, and 3 I carried are 80—set down 0 and carry 8—11 times 1 is 11, and 8 are 19; the half of 19 is 9 and 1 over; set 1 on the left side of 0, and carry 9 to the pounds.

Pounds.

Eleven times 6 are 66, and 9 that I carried are 75; set down 75.

Answer in words, Seventy-five pounds, ten shillings, and five pence, one farthing.

Proof of lesson 10.

11)75 10 5 1
£6 17 3 3

Pounds.

How many times 11 in 75? 6 times and 9 over; set down 6, and carry 9 to the shillings: now [illegible] pounds must be reduced into shillings, and added to the 10 shillings.

KEY TO CARD No. 18.

Shillings.

Twenty shillings make 1 pound, and 9 pounds make 180 shillings—This you may know by multiplying 20 by 9 on some part of your slate, thus,

20
9
—
180

then add the 10 shillings, which will make 190 shillings: now how many times 11 in 190? make a memorandum on some part of your slate, and divide 190 by 11—we can have 17 times and 3 over; set down 17 in the place of shillings, and carry 3 to the pence.

Pence.

Three shillings over that I carried, are 36 pence, and 5 are 41—how many times 11 in 41—3 times and 8 over—set down 3 and carry 8 to the farthings.

Farthings.

Eight pence over I carried make 32 farthings, and 1 makes 33—how many times 11 in 33?—3 times; set down 3.

LESSON 11.

When geese are sold at £1 16 4 2 a dozen, what must I give for 12 doz.? 12

Answer, £21 16 6 0

Farthings.

Twelve times 2 are 24—24 farthings make 6 pence; set down 0 and carry 6 to the pence.

Pence.

Twelve times 4 are 48, and 6 I carried are 54—54 pence are 4*s.* 6*d.*; set down 6 pence, and carry 4*s.* to the shillings.

Shillings.

Twelve times 6 are 72, and 4 I carried are 76—6 and carry 7—12 times 1 are 12, and 7 are 19—the half of 19 is 9, and 1 over; set down 1 on the left side of 6, and carry 9 to the pounds.

KEY TO CARD No. 18.

Pounds.

Twelve times 1 is 12, and 9 are 21; set down 21.

Answer in words, Twenty-one pounds sixteen shillings and six pence.

PROOF OF LESSON 11.

12)21 16 6 0 How many times 12 in 21?—once,
1 16 4 2 and 9 over: set down 1 and carry 9 to the shillings.

Shillings.

Nine pounds over I carried, make 180 shillings, and 16 are 196. How many times 12 in 196? 16 times and 4 over; set down 16 and carry 4 to the pence.

Pence.

Four shillings over I carried make 48 pence, and 6 are 54—how many times 12 in 54—4 times and 6 over; set down 4 and carry 6 to the farthings.

Farthings.

Six pence over I carried, make 24 farthings; how many times 12 in 24?—twice—set down 2.

LESSON 12.

When oil sells at	£ 14	16	8	2	a barrel, what
must I pay for 13 barrels?				12	
The price of 12 barrels,	£ 178	0	6	0	
The price of 1 barrel added,	14	16	8	2	
The amount of 13 barrels,	£ 192	17	2	2	

DIRECTIONS.

Multiply by 12, and the product will give the price of 12 barrels, then add to that product the price of 1 barrel.

Farthings.

Twelve times 2 are 24—24 farthings make 6 pence; set down 0 and carry 6 to the pence.

Pence.

Twelve times 8 are 96, and 6 are 102—102 pence are 8*s.* 6*d.* set down 6, and carry 8 to the shillings.

KEY TO CARD No. 18.

Shillings.

Twelve times 6 are 72, and 8 I carried are 80—0 and carry 8— 12 times 1 are 12, and 8 are 20—the half of 20 is 10—carry 10 to the pounds.

Pounds.

Twelve times 4 are 48, and 10 I carried are 58; set down 8 and carry 5.

Twelve times 1 is 12 and 5 are 17; set down 17. To this sum, add the price of 1 barrel.

Answer in figures, £ 192 17 2 2

Answer in words, One hundred and ninety-two pounds seventeen shillings and two pence half-penny.

PROOF OF LESSON 12.

Subtract the price of one barrel, from £ 192 17 2 2, and divide the remainder by 12.

```
£ 192 17  2  2
   14 16  8  2 Subtracted.
--------------
£ 178  0  6  0 to be divided by 12.
```

```
12)178  0  6  0
    14 16  8  2
```

Pounds.

How many times 12 in 17? once and 5 over—12 in 58?—4 times, and 10 over—carry 10 to the shillings.

Shillings.

Ten pounds over I carried, make 200 shillings; how many times 12 in 200?—16 times, and 8 over; set down 16, and carry 8 to the pence.

Pence.

Eight shillings over I carried, make 96 pence, and 6 are 102—how many times 12 in 102?—8 times and 6 over; set down 8, and carry 6 to the farthings.

Farthings.

Six pence over I carried, make 24 farthings—how many times 12 in 24? twice; set down 2.

Proof, £ 14 16 8 2.

LESSON 13.

What will 14 Oxen cost at the rate of £ 17 6 8 an ox?

KEY TO CARD No. 18.

Multiply this given sum by 2 and that product by 7.

£ 17 6 8   £ 34 13 4
2   7

£ 34 13 4   £ 242 13 4 Answer.

Pence.

Twice 8 are 16—16 pence make 1*s.* 4*d.*; set down 4, and carry 1 to the shillings.

Shillings.

Twice 6 are 12, and 1 I carried makes 13; set down 13.

Pounds.

Twice 17 are 34; set down 34.

Thus we have the price of 2 oxen; and as 7 times 2 are 14; so 7 times the price of 2 oxen, will give the price of 14.

Multiply £ 34 13 4, the price of 2, by 7.
7

£ 242 13 4

Pence.

Seven times 4 are 28—28 pence are 2*s.* 4*d.*; set down 4 and carry 2 to the shillings.

Shillings.

Seven times 3 are 21—and 2 I carried are 23—3 and carry 2—7 times 1 is 7, and 2 are 9—the half of 9 is 4 and *1* over; set down 1 on the left side of 3, and carry 4 to the pounds.

Pounds.

Seven times 4 are 28, and 4 I carried are 32: set down 2 and carry 3. Seven times 3 are 21, and 3 I carried are 24; set down 24.

Answer in figures, £242 13 4. In words, Two hundred and forty-two pounds thirteen shillings and four pence.

Proof of lesson 13.

Divide £ 242 13 4, the price of the oxen, by 7, and that quotient by 2. The last quotient will be the proof.

7)242 13 4   2)34 12 4
34 13 4   17 6 8

KEY TO CARD No. 18.

First division.

How many times 7 in 24? 3 times and 3 over—7 in 32?—4 times, and 4 over I carry to the shilllings.

Shillings.

Four pounds over I carried make 80*s*. and 13*s*. make 93—how many times 7 in 93?—13 times, and 2 over—carry 2 to the pence.

Pence.

Two shillings over I carried, make 24 pence, and 4 are 28—7 in 28?—4 times.

Second division.

How many times 2 in 34?—17 times.

Shillings.

How many times 2 in 13?—6 times and 1 over I carry to the pence.

Pence.

One shilling over I carried, is 12 pence, and 4 are 16—2 in 16?—8 times.

LESSON 14.

Multiply £461 17 4 by 15.

Multiply this given sum by 5, and that product by 3, the last product will be the answer.

As 5 times 1 is 5, and 3 times 5 are 15; so any *number*, multiplied by 5 and by 3, will produce a product 15 times greater than such *number*.

EXAMPLE.

£461	17	4	£2309	6	8
		5			3
£2309	6	8	£6928	0	0

Pence.

Five times 4 are 20—20 pence are 1*s*. 8*d*.; set down 8, and carry 1 to the shillings.

Shillings.

Five times 7 are 35, and one I carried makes 36—6 and carry 3—5 times 1 is 5, and 3 are 8—the half of 8 is 4—carry 4 to the pounds.

KEY TO CARD No. 18.

Pounds.

Five times 1 is 5, and 4 I carried are 9—set down 9—5 times 6 are 30—0 and carry 3—5 times 4 are 20, and 3 are 23.

SECOND MULTIPLICATION.

Three times 8 are 24—24 pence make 2*s.*; set down 0 and carry 2 to the shillings.

Shillings.

Three times 6 are 18, and 2 are 20; set down 0 and carry 1 to the pounds, because 20*s.* make 1 pound.

Pounds.

Three times 9 are 27 and one I carried makes 28—8 and carry 2—3 times 0 is 0, but 2 is 2; set down 2—3 times 3 are 9—9 and carry nothing—3 times 2 are 6.

Answer in words, Six thousand nine hundred and twenty-eight pounds.

LESSON 15.

What sum will be produced by multiplying £0 18 9 by 16?

DIRECTIONS.

Multiply 18*s.* 9*d.* by 4, and that product by 4, the last product will be the answer.

4

3 15 0

4

£ 15 0

Pence.

Four times 9 are 36—36 pence are 3 shillings; set down 0 and carry 3 to the shillings.

Shillings.

Four times 8 are 32, and 3 I carried are 35—5 and carry 3—4 times 1 are 4, and 3 are 7—the half of 7 is 3, and 1 over; set 1 by the 5, and carry 3 to the pounds.

Pounds.

Four times 0 is 0, but 3 I carried make 3. Thus for the first product we have £ 3 15.

SECOND MULTIPLYING.

Four times 15 are 60—60 shillings make 3 pounds; set down 0 and carry 3 to the pounds.

KEY TO CARD No. 18.

Pounds.

Four times 3 are 12, and 3 I carried are 15; set down 15. Answer in words, Fifteen pounds.

LESSON 16.

If 1 pound of Indigo cost £ 0 19 6, what cost 17 pounds?

Multiply by 4 and by 4, you will then have the price of 16 pounds—add the price of 1 pound, which will give the answer.

£ 0	19	6	Price of 1 lb. or Multiplicand.
		4	First Multiplier.
3	18	0	First Product—price of 4 lb.
	4		Second Multiplier.
15	12		Second Product—price of 16 lb.
	19	6	Price of 1 lb. added.
£ 16	11	6	Price of 17 lb.

Pence.

Four times 6 are 24—24 pence make 2 shillings; set down 0 and carry 2 to the shillings.

Shillings.

Four times 9 are 36 and 2 I carried are 38—8 and carry 3—4 times 1 are 4 and 3 are 7—the half of 7 is 3 and 1 over; set 1 by 8 and carry 3 to the pounds.

Pounds.

Four times 0 is nothing, but 3 I carried are 3; set 3 in the pounds.

SECOND MULTIPLYING.

Shillings.

Four times 8 are 32—2 and carry 3—4 times 1 is 4, and 3 are 7—the half of 7 is 3 and 1 over; set 1 by the 2, and carry 3 to the pounds.

Pounds.

Four times 3 are 12, and 3 I carried are 15; set down 15.

KEY TO CARD No. 18.

We have for a product,	£ 15	12	0
Add to this the price of 1 lb. viz.		19	6
Answer,	£ 16	11	6

KEY TO CARD No. 19.

LESSON 17.

If a yard of linen cost 5*s.* 9*d.* what cost 35 yards?

Multiply by 7, and the product thence arising by 5; the last product will be the answer.

£ 0	5	9
		7
2	0	3
		5
£ 10	1	3

Begin with the Pence.—7 times 9 are 63—63 pence are 5*s.* 3*d.*—set down 3 and carry 5 to the shillings.

Shillings.

Seven times 5 are 35, and 5 I carried are 40—40*s.* make 2 pounds; set down 0 in the place of shillings, and 2 in the pounds.

This operation gives a product of £ 2 0 3, which is 7 times greater than the given sum, and it must be multiplied by 5; then it will be 5 times 7 times greater, or 35 times greater.

Pence.

Five times 3 are 15—15 pence make 1*s.* 3*d.*—set down 3 and carry 1 to the shillings.

Shillings.

Five times 0 is 0, but one I carried makes 1; set down 1—then say, 5 times 2 are 10, and set down 10 in the pounds.

Answer in words, Ten pounds one shilling and three pence.

LESSON 18.

When apples are sold at 1*d.* 1*q.* what will 700 cost?

Multiplying by 10 and that product by 10 will make the price of 100; then the price of 100 multiplied by 7, will give the answer.

KEY TO CARD No. 19.

£0	0	1	1
			10
	1	0	2
			10
	10	5	0
		7	
£3	12	11	

Farthings.

Ten times 1 is 10—10 farthings make 2 pence 2 farthings; set down 2 and carry 2 to the pence.

Pence.

Ten times 1 is 10, and 2 I carried make 12—12 pence make 1 shilling; set down 0 in the place of pence, and 1 in the place of shillings. Thus, 1*s.* 0*d.* 2*q.* is the product of 1*d.* 1*q.* multiplied by 10: now multiply this sum by 10—the product will be the price of 100.

Farthings.

Ten times 2 are 20—20 farthings make 5 pence; set down 0 in the place of farthings, and carry 5 to the pence.

Pence.

Ten times 0 is 0, but 5 I carried make 5; set down 5.

Shillings.

Ten times 1 is 10; set down 10.

Now we have a product of 10*s.* 5*d.* the price of 100—Multiply this by 7.

Pence.

Seven times 5 are 35—35 pence make 2*s.* 11*d.*; set down 11, and carry 2 to the shillings.

Shillings.

Seven times 10 are 70, and 2 I carried are 72—72*s.* make 3 pounds 12 shillings; set 12 in the place of shillings, and 3 in the pounds.

By this calculation we find, that 700 apples, at 1*d.* 1*q.* each, amount to £ 3 12 11.

Answer in words, Three pounds twelve shillings and eleven pence.

LESSON 19.

If 1 pair of gloves cost £ 0 3 7, what will 57 pair cost?

KEY TO CARD No. 19.

£0	3	7
		7
1	5	1
		8
10	0	8
	3	7
£10	4	3

Multiply by 7 and by 8, then add to the last product, 3*s.* 7*d.* the price of one pair.

Pence.

Seven times 7 are 49—49 pence make 4*s.* 1*d.*; set down 1 and carry 4 to the shillings.

Shillings.

Seven times 3 are 21, and 4 I carried make 25—25*s.* are 1 pound 5 shillings; set down 5 in the place of shillings, and 1 in the pounds.

Thus we see that 7 pair amount to £1 5 1, and as 8 times 7 are 56, so 8 times this sum will give the price of 56 pair.

SECOND MULTIPLICATION.

Eight times 1 is 8; set 8 in the pence.

Eight times 5 are 40—40*s.* make 2 pounds; set 0 in the place of shillings, and carry 2.

Eight times 1 is 8, and 2 I carry make 10; set 10 in the pounds.

This operation produces a product of £10 0 8, the price of 56 pair—add the price of one pair, viz: 3*s.* 7*d.* you will have the price of 57 pair.

Answer in words, Ten pounds four shillings and three pence.

LESSON 20.

When stockings are sold at £0 7 9 a pair, what will 68 pair come to?

£0	7	9	
		6	
2	6	6	
		11	
£25	11	6	Price of 66 pair.

Multiply by 6 and by 11, this will give the price of 66 pair.

KEY TO CARD No. 19.

Now multiply 7*s*. 9*d*. the price of one pair, by 2; the product will be the price of 2 pair—add this price to that of 66 pair, you will have the answer.

Price of one pair,	£ 0	7	9	
Multiplier,			2	
Price of two pair,	£ 0	15	6	
Price of 66 pair,	25	11	6	
Price of 68 pair,	£ 26	7	0	Ans.

Pence.

Six times 9 are 54—54 pence make 4*s*. 6*d*.; set down 6 and carry 4 to the shillings.

Shillings.

Six times 7 are 42, and 4 I carried are 46—46 shillings are 2 pounds 6 shillings; set down 6 in the shillings and 2 in the pounds.

Here we find a product of £ 2 6 6 the price of 6 pair; Multiply this sum by 11—the product will be the price of 11 times 6 pair, that is, 66 pair.

Pence.

Eleven times 6 are 66—66 pence are 5*s*. 6*d*.; set down 6, and carry 5 to the shillings.

Shillings.

Eleven times 6 are 66, and 5 I carried make 71—71 shillings are 3 pounds 11 shillings; set down 11 and carry 3 to the pounds.

Pounds.

Eleven times 2 are 22, and 3 I carried are 25.

Thus we have a product of £ 25 11 6, for the price of 66 pair—Add the price of 2 pair, you will have the Answer.

One Pair,	7*s*. 9*d*.
Multiplied by	2
Makes	15*s*. 6*d*.

KEY TO CARD No. 19.

Pence.

Twice 9 are 18—18 pence make 1*s.* 6*d.*; set down 6 in the pence, and carry 1.

Shillings.

Twice 7 are 14, and one I carried makes 15.

Here we find the price of 2 pair to be	£0	15	6
and *there* the price of 66 pair was,	25	11	6
Added,			
Make,	£26	7	0

Answer in words, Twenty-six pounds, seven shillings.

LESSON 21.

What sum must be paid for 1155 pounds of beef, at 4*d.* 2*q.* a pound?

1. Multiply by 10 and by 10 to find the price of 100 pounds.

2. Multiply that product by 11, which operation will give the price of 1100 pounds.

3. Multiply 4*d.* 2*q.* by 11 and by 5 to find the price of 55 pounds.

4. Add the price of 55 pounds to the price of 1100, and you will have the answer.

A	£0 0 4 2	The price of 1 pound.
	10	Multiplied by 10.
B	3 9 0	The price of 10 pounds.
	10	Multiplied by 10.
C	1 17 6	The price of 100 pounds.
	11	Multiplied by 11.
D	20 12 6	The price of 1100 pounds.

KEY TO CARD No. 19.

	£.	*s.*	*d.*	*q.*	
Aa	0	0	4	2	The price of 1 pound.
				11	Multiplied by 11.
E		4	1	2	The price of 11 pounds,
				5	Multiplied by 5.
F	1	0	7	2	The price of 55 pounds.
Dd	20	12	6	0	The price of 1100 pounds.
					Added to 55 pounds.
G	21	13	1	2	The price of 1155 pounds.

Farthings, opposite A.

Ten times 2 are 20—20 farthings make 5 pence; set down 0 and carry 5 to the pence.

Pence.

Ten times 4 are 40, and 5 I carry make 45—45 pence make 3*s*. 9*d*.; set down 3*s*, 9*d*. which is the price of 10 pounds. Now multiply the price of 10 pounds by 10, the product will be the price of 100 pounds.

Pence, opposite B.

Ten times 9 are 90—90 pence make 7*s*. 6*d*.; set down 6 and carry 7.

Shillings.

Ten times 3 are 30, and 7 are 37—37*s*. make 1 pound 17 shillings; set down £ 1 17. This product is the price of 100—Multiply it by 11 and you will have the price of 11 hundred.

Pence, opposite C.

Eleven times 6 are 66—66 pence are 5*s*. 6*d*.; set down 6 and carry 5 to the shillings.

Shillings.

Eleven times 7 are 77, and 5 I carried are 82—2 and carry 8—11 times 1 is 11, and 8 are 19—the half of 19 is 9 and 1 over; set the 1 in tens' place of shillings, and carry 9 to the pounds.

KEY TO CARD No. 19.

Pounds.

Eleven times 1 is 11, and 9 I carried make 20—set 20 in the place of pounds.

Thus we have £ 20 12 6 for the price of 1100 pounds.

Now multiply the price of one pound by 11 and by 5, to find the price of 55 pounds—add this price to that of 1100 pounds, and you will have the answer.

Farthings, opposite A a.

Eleven times 2 are 22—22 farthings make *5d. 2q.*; set down 2 and carry 5.

Pence.

Eleven times 4 are 44, and 5 I carried are 49—49*d.* make 4*s.* 1*d.*; set down 1 in the pence and 4 in the shillings.

Farthings, opposite E.

Five times 2 are 10—10 farthings make 2 pence 2 farthings; set down 2 and carry 2 to the pence.

Pence.

Five times 1 is 5 and 2 I carried are 7—set down 7 in the pence.

Shillings.

Five times 4 are 20—20*s.* make 1 pound; set down 0 in the shillings, and 1 in the place of pounds. This makes £ *1 0 7* 2 for the price of 55 pounds.

£ 1 0 7 2 Price of 55 pounds, added
To 20 12 6 0 the price of 1100 pounds,

Makes £ 21 13 1 2 the Answer for 1155 lb.

Answer in words, Twenty-one pounds thirteen shillings and one penny half-penny.

When an *Integer*, that is, *a whole number*, costs so much a pound, what will a hundred weight cost?

RULE.

Multiply the *price* of one Integer by 7 and by 8, and the second product by 2: the third product will be the price *of 112.*

KEY TO CARD No. 19.

NOTE 1st.—A hundred weight Avoirdupois contains 112 pounds; consequently any number being multiplied by 7, and that product by 8, will make a product 56 times the first number; and this second product multiplied by 2, will make a product 112 times greater than the first number.

$1\times7=7\times8=56$ and $56\times2=112$.

Read thus, 1 multiplied by 7 equals 7, multiplied by 8 equals 56; and 56 multiplied by 2 equals 112.

NOTE 2nd.—It will make no difference to multiply by 8 first, then by 7.

LESSON 22.

EXAMPLE.

If 1 pound of indigo cost £0 17 5 what will 112 pounds cost, that is, what will one hundred weight *Avoirdupois* cost?

£0	17	5	Price of 1 pound.
		8	
6	19	4	Price of 8 pounds.
		7	
48	15	4	Price of 56 pounds.
		2	
£97	10	8	Price of 112 pounds.

Pence.

Eight times 5 are 40—40 pence make 3*s.* 4*d.*; set down 4 and carry 3 to the shillings.

Shillings.

Eight times 7 are 56, and 3 I carried are 59—9 and carry 5—8 times 1 is 8 and 5 are 13; the half of 13 is 6 and 1 over, place 1 by the 3 and carry 6 to the place of pounds.

This operation makes a product of £6 19 4. Multiply this sum by 7.

Pence.

Seven times 4 are 28—28 pence make 2*s.* 4*d.*; set down 4 and carry 2.

Shillings.

Seven times 9 are 63, and 2 I carried are 65—5 and carry 6—7 times 1 is 7, and 6 are 13—the half of 13 is 6 and 1 over; set 1 by the 9 and carry 6 to the pounds.

KEY TO CARD No. 19.

Pounds.

Seven times 6 are 42, and 6 I carried are 48; set 48 in the pounds.

This makes a product of £ 48 15 4 the price of 56 pounds—Multiply this sum by 2.

Pence.

Twice 4 are 8; set down 8 and carry nothing—twice 15 are 30—30*s.* make 1 pound 10 shillings; set down 10 for shillings, and carry 1 to the pounds.

Twice 8 are 16, and one I carried makes 17; set down 7 and carry 1—twice 4 are 8 and 1 makes 9; set down 9.

Thus we have a sum of £ 97 10 8 for the answer.

LESSON 23.

When fish come at £ 0 0 5 a pound, what will a hundred weight cost?

	£ 0	0	5
			8
The price of 8 pounds,	0	3	4
			7
The price of 56 pounds,	1	3	4
			2
The price of 112 pounds,	£ 2	6	8

Pence.

Eight times 5 are 40—40 pence equal 3*s.* 4*d.*; set 4 in the pence, and 3 in the shillings.

SECOND OPERATION.

Seven times 4 are 28—28 pence are 2*s.* 4*d.*; set down 4 and carry 2.

Seven times 3 are 21 and 2 are 23; set down £ 1 3.

Here we have a sum of £ 1 3 4 for the price of 56 pounds, which sum when multiplied by 2, will give a product for the price of 112 pounds.

KEY TO CARD No. 19.

Pence.

Twice 4 are 8; set down 8 in the pence.

Shillings.

Twice 3 are 6; set 6 in the shillings.

Pounds.

Twice 1 is 2; set 2 in the pounds.

Answer in words, Two pounds six shillings and eight pence.

END OF PART FOURTH.

INTRODUCTION TO ARITHMETIC,

PART V.

CONTAINING,

COMMON MULTIPLICATION.

MULTIPLICATION.

KEY TO CARD No. 20.

Inform the learners that the number to be multiplied is called the *Multiplicand.*

The number we multiply by, *Multiplier,* and the result or sum total, the *Product.*

Let them also know, that the Multiplicand and Multiplier are called *Factors:* that is, the upper and lower factor; and it makes no difference in the Product which number stands uppermost; only place the smallest Factor under for the case of multiplying.

LESSON 1.

```
Multiplicand,4 6 4 3 2 upper Factor,
Multiplier,        5 2 4 lower Factor,
            -------------
              1 8 5 7 2 8  Interme-
            9 2 8 6 4      diate Pro-
        2 3 2 1 6 0        ducts.
        -----------------
        2 4,3 3 0,3 6 8 Product.
```

Here give notice how the figures must be arranged in the several intermediate Products. Always place the first figure of a product exactly under its Multiplier.

Begin with the 4 the first figure on the right of the Multiplier.

Four times 2 are 8; set 8 exactly under the 4—4 times 3 are 12; set 2 on the left side of 8 and carry 1—4 times

KEY TO CARD No. 20.

4 are 16 and 1 I carried is 17; set down 7 and carry 1—4 times 6 are 24 and 1 I carried makes 25; set down 5 and carry 2—4 times 4 are 16 and 2 are 18; set down 18.

Second.

Twice 2 are 4—set 4 under the 2—Twice 3 are 6; set 6 under the 7—Twice 4 are 8; set 8 under the 5—Twice 6 are 12; set 2 under the 8 above and carry 1—Twice 4 are 8 and one I carried makes 9; set 9 under the 1.

Third.

Five times 2 are 10; set 0 under the 6—5 times 3 are 15 and 1 I had to carry make 16—set 6 under the 8 and carry 1—5 times 4 are 20 and one I carried makes 21; set 1 under the 2 and carry 2—5 times 6 are 30 and 2 I carried are 32; set 2 under the 9 and carry 3—5 times 4 are 20 and 3 I carried are 23; set 23 on the left side of the whole.

Add these 3 products as in addition of whole numbers.

Eight is 8—4 and 2 are 6—6 and 7 are 13; 3 and carry 1—1 to 6 makes 7 and 8 are 15 and 5 are 20—0 and carry 2—2 to 1 is 3 and 2 are 5 and 8 are 13—3 and carry 1—1 to 2 makes 3 and 9 are 12 and 1 is 13—3 and carry 1—1 to 3 makes 4—2 make 2.

Product in words, Twenty-four million three hundred and thirty thousand three hundred and sixty-eight.

Now let each one become expert in reading figures—Let the Numeration Table hang in view.

LESSON 2.

Multiplicand, 6 1 2 4 8
Multiplier, 7 3 2

1 2 2 4 9 6
1 8 3 7 4 4
4 2 8 7 3 6

Product 4 4,8 3 3,5 3 6

First.

Twice 8 are 16—6 and carry 1—twice 4 are 8 and 1 is 9—twice 2 are 4—twice 1 is 2—twice 6 are 12.

Second.

Three times 8 are 24—4 and

KEY TO CARD No. 20.

carry 2—3 times 4 are 12 and 2 are 14—4 and carry 1—3 times 2 are 6 and 1 is 7—3 times 1 are 3—3 times 6 are 18.

Third.

Seven times 8 are 56—6 and carry 5—7 times 4 are 28 and 5 are 33—3 and carry 3—7 times 2 are 14 and 3 are 17—7 and carry 1—7 times 1 is 7 and 1 is 8—7 times 6 are 42.

Add these intermediate Products.

Total product in words, Forty-four million eight hundred and thirty-three thousand five hundred and thirty-six.

LESSON 3.

Multiplicand,	1 6 7 3 9
Multiplier,	2 8 7
	1 1 7 1 7 3
	1 3 3 9 1 2
	3 3 4 7 8
Product,	4,8 0 4,0 9 3

First.

Seven times 9 are 63—3 and carry 6—7 times 3 are 21 and 6 are 27—7 and carry 2—7 times 7 are 49 and 2 are 51—1 and carry 5—7 times 6 are 42 and 5 are 47—7 and carry 4—7 times 1 is 7 and 4 are 11.

Second.

Eight times 9 are 72—2 and carry 7—8 times 3 are 24 and 7 are 31—1 and carry 3—8 times 7 are 56 and 3 are 59—9 and carry 5—8 times 6 are 48 and 5 are 53—3 and carry 5—8 times 1 is 8 and 5 are 13.

Third.

Twice 9 are 18—8 and carry 1—Twice 3 are 6 and 1 is 7—7 and carry nothing—Twice 7 are 14—4 and carry 1—Twice 6 are 12 and 1 is 13—3 and carry 1—Twice 1 is 2 and 1 is 3.

Add the intermediate Products.

Total Product in words, Four million eight hundred and four thousand and ninety-three.

KEY TO CARD No. 20.

LESSON 4.

4567
6524

18268
9134
22835
27402

29,795,108

First.

Four times 7 are 28—8 and carry 2—4 times 6 are 24 and 2 are 26—6 and carry 2—4 times 5 are 20 and 2 are 22—2 and carry 2—4 times 4 are 16 and 2 are 18.

Second.

Twice 7 are 14—4 and carry 1—twice 6 are 12 and 1 is 13—3 and carry 1—twice 5 are 10 and 1 is 11—1 and carry 1—twice 4 are 8 and 1 is 9.

Third.

Five times 7 are 35—5 and carry 3—5 times 6 are 30 and 3 are 33—3 and carry 3—5 times 5 are 25 and 3 are 28—8 and carry 2—5 times 4 are 20 and 2 are 22.

Fourth.

Six times 7 are 42—2 and carry 4—6 times 6 are 36 and 4 are 40—0 and carry 4—6 times 5 are 30 and 4 are 34—4 and carry 3—6 times 4 are 24 and 3 are 27.

Add the intermediate Products.

Total Product in words, Twenty-nine million seven hundred and ninety-five thousand one hundred and eight.

LESSON 5. See Card No. 21.

Multiplicand, 4 8 7 6
Multiplier, 6 5 4 3

1 4 6 2 8
1 9 5 0 4
2 4 3 8 0
2 9 2 5 6

Product, 3 1, 9 0 3, 6 6 8

First figure of the Multiplier,

Three times 6 are 18—8 and carry 1—3 times 7 are 21 and 1 is 22—2 and carry 2—3 times 8 are 24 and 2 are 26—6 and carry 2—3 times 4 are 12 and 2 are 14,

KEY TO CARD No. 21.

Second.

Four times 6 are 24—4 and carry 2—4 times 7 are 28 and 2 are 30—0 and carry 3—4 times 8 are 32 and 3 are 35—5 and carry 3—4 times 4 are 16 and 3 are 19.

Third.

Five times 6 are 30—0 and carry 3—5 times 7 are 35 and 3 are 38—8 and carry 3—5 times 8 are 40 and 3 are 43—3 and carry 4—5 times 4 are 20 and 4 are 24.

Fourth.

Six times 6 are 36—6 and carry 3—6 times 7 are 42 and 3 are 45—5 and carry 4—6 times 8 are 48 and 4 are 52—2 and carry 5—6 times 4 are 24 and 5 are 29.

Add the intermediate Products.

Total product in words, Thirty-one million nine hundred and three thousand six hundred and sixty-eight.

LESSON 6.

$$\begin{array}{lr}
\text{Multiplicand,} & 5\,6\,7\,8 \\
\text{Multiplier,} & 8\,7\,6\,5 \\ \hline
 & 2\,8\,3\,9\,0 \\
 & 3\,4\,0\,6\,8 \\
 & 3\,9\,7\,4\,6 \\
 & 4\,5\,4\,2\,4 \\ \hline
 & 4\,9{,}7\,6\,7{,}6\,7\,0
\end{array}$$

First.

Five times 8 are 40—0 and carry 4—5 times 7 are 35 and 4 are 39—9 and carry 3—5 times 6 are 30 and 3 are 33—3 and carry 3—5 times 5 are 25 and 3 are 28.

Second.

Six times 8 are 48—8 and carry 4—6 times 7 are 42 and 4 are 46—6 and carry 4—6 times 6 are 36 and 4 are 40—0 and carry 4—6 times 5 are 30 and 4 are 34.

Third.

Seven times 8 are 56—6 and carry 5—7 times 7 are 49 and 5 are 54—4 and carry 5—7 times 6 are 42 and 5 are 47—7 and carry 4—7 times 5 are 35 and 4 are 39.

KEY TO CARD No. 21.

Fourth.

Eight times 8 are 64—4 and carry 6—8 times 7 are 56 and 6 are 62—2 and carry 6—8 times 6 are 48 and 6 are 54—4 and carry 5—8 times 5 are 40, and 5 are 45.

Add the intermediate Products.

Total Product in words, Forty-nine million seven hundred and sixty seven thousand six hundred and seventy.

LESSON 7.

$$\begin{array}{lr}
\text{Multiplicand,} & 9\ 8\ 7\ 0\ 0 \\
\text{Multiplier,} & 6\ 5\ 4\ 0 \\ \hline
 & 3\ 9\ 4\ 8 \\
 & 4\ 9\ 3\ 5 \\
 & 5\ 9\ 2\ 2 \\ \hline
\text{Product,} & 6\ 4\ 5{,}4\ 9\ 8{,}0\ 0\ 0
\end{array}$$

Multiply by 4, by 5, and by 6, paying no regard to the ciphers.

First.

Four times 7 are 28—8 and carry 2—4 times 8 are 32 and 2 are 34—4 and carry 3—4 times 9 are 36 and 3 are 39.

Second.

Five times 7 are 35—5 and carry 3—5 times 8 are 40 and 3 are 43—3 and carry 4—5 times 9 are 45 and 4 are 49.

Third.

Six times 7 are 42—2 and carry 4—6 times 8 are 48 and 4 are 52—2 and carry 5—6 times 9 are 54 and 5 are 59.

Add the intermediate Products.

We have now a total Product of 645498—annex the three ciphers, that is, place them on the right hand of these figures and they will make the answer required, viz: 645,498,000.

Product in words, Six hundred and forty-five million four hundred and ninety-eight thousand.

KEY TO CARD No. 21.

LESSON 8.

Multiplicand, 4 0 7 8 0
Multiplier, 1 6 0 0
2 4 4 6 8
4 0 7 8
Product, 6 5,2 4 8,0 0 0

Multiply by the two figures, add the intermediate products, then count the ciphers and annex them to the total product.

First.

Six times 8 are 48—8 and carry 4—6 times 7 are 42 and 4 are 46—6 and carry 4—6 times 0 is 0 but 4 is 4—6 times 4 are 24.

Second.

Once 8 is 8—once 7 is 7—once 0 is 0 once 4 is 4.

Add—bring down the ciphers.

Total Product in words, Sixty-five million two hundred and forty-eight thousand.

LESSON 9.

9 9 9 0 0
7 0 0
6 9,9 3 0,0 0 0

Multiply by the 7.

Seven times 9 are 63—3 and carry 6—7 times 9 are 63 and 6 are 69—9 and carry 6—7 times 9 are 63 and 6 are 69.

Bring down the ciphers—They make Sixty-nine million nine hundred and thirty thousand.

LECTURING.

What do we understand by the word NOTATION?

Notation is the recording or noting any number of objects or things: in Arithmetic it signifies the writing down any number of figures, as, 1 2 3 4.

What is meant by NUMERATION?

The act of numbering after figures are noted or written; for instance, read the figures, 1, 2, 3, and 4, thus, One thousand two hundred and thirty-four.

What is ADDITION?

Addition is the combining of several numbers together, as, 3 more 5, more 6, more 7, equal 21. Or, 3 added to 5, added to 6, added to 7, equal 21 for a RESULT or SUM TOTAL.

What do we understand by the word SUBTRACTION?

Subtraction is the lessening of any quantity, as, the number 15 taken from 20, leaves 5 for a REMAINDER.

What is the arithmetical name of the upper number in Subtraction? Call it MAJOR or MINUEND: the middle number we will call MINOR or SUBTRAHEND, and the lowermost number, REMAINDER.

NOTE 1.—It may be well to call these numbers *Minuend* and *Subtrahend*.

NOTE 2.—This Rule partakes of the nature of Division, as for example: subtract 4 from 24, five times, the *remainder* will be 4, the same as the *quotient* of 24 when divided by 6: that is, 24 less 4, equals 20; 20 less 4, equals 16; 16 less 4, equals 12; 12 less 4, equals 8; 8 less 4, equals 4. Or, how many times 6 in 24? 4 times.

What is MULTIPLICATION?

Multiplication is the increasing of numbers with rapidity, instead of a tedious and slow way of operating by Addition, thus, 5 times 8 are 40; instead of 8 and 8 are 16, and 8 are 24, and 8 are 32, and 8 are 40.

By what name shall we call the terms in this Rule?

The Number to be multiplied is called, MULTIPLICAND; the number we multiply by, MULTIPLIER; and the lowermost number, PRODUCT. The Multiplicand and Multiplier are also called Factors; and may be termed, upper and lower Factor.

NOTE.—When the lower Factor consists of several figures, there will be more products than one, and they may be called *Intervening* or *Intermediate* Products.

How shall we define Division?

Division is a concise way of working Subtraction, or of apportioning a larger number into smaller and equal parts; as, 41 dollars divided between 5 men, will give each man 8, and 1 over for a Remainder. This mode is easier than to subtract from 40 the number 5 eight times to find an Answer.

What are the names of the terms in Division?

The Number we divide by, is called DIVISOR; that which we divide, DIVIDEND; the Result or Answer, QUOTIENT; and if any thing be left undivided, it is a REMAINDER.

Classes may lecture in this manner on some day appointed, and the most expert may be entitled to precedence as in spelling.

END OF PART FIFTH.

INTRODUCTION TO ARITHMETIC,

PART VI.

CONTAINING,

LONG DIVISION.

LONG DIVISION.

KEY TO CARD No. 23.

LESSON 1.

In 79,392 ounces Avoirdupois, how many pounds, allowing 16 ounces to each pound?

```
16)79392(4962
   64
   ——
   153
   144
   ———
    99
    96
    ——
     32
     32
     ——
```

NOTE.—16 is the *Divisor.*

79392 is the *Dividend.*

4962 is the *Quotient.*

When any number of figures remain in the place of the two periods under 32, such number will be called the *Remainder.*

Let the Division Table, Card No. 22, be suspended before the class.

The monitor will direct the class to prepare their lesson on the slates, as it is represented on Card No. 23.

Then say, how many times 16 in 79? Look at the Table under 16—Begin at the last number opposite 16, that is, 144; count upwards till you find a number less than 79, say 64—opposite 64 you will find 4 times—Then say, I can have 4 times 16 in 79; set 4 in the quotient.

Now multiply 16 by 4, and place the product under 79.

Four times 6 are 24—4 and carry 2—4 times 1 is 4 and 2 are 6—thus we have 64 standing under 79.

KEY TO CARD No. 23.

Subtract this number 64 from 79—the remainder is 15.

Bring down the next figure in the dividend, that is, 3, and place it on the right hand side of 15, which will make 153.

Now say, how many times 16 in 153?

Look at the last number in the Table under 16, which is 144, opposite that stands 9 times—as 144 is less than 153, I find that 16 will be contained 9 times in 153; set 9 in the quotient.

Multiply the divisor 16 by 9, and set the product under 153.

Nine times 6 are 54—4 and carry 5—9 times 1 is 9 and 5 are 14.

Thus we have the number 144 under 153.

Subtract this number 144 from 153. The remainder is 9.

Bring down the next figure from the dividend, that is 9, which will make 99.

How many times 16 in 99?

Begin at the lowermost number under 16 in the Table, say 144, and look upwards till you find a number less than 99, let it be 96—opposite 96 stands 6 times.

Set 6 in the quotient, and multiply 16 by 6.

Six times 6 are 36—6 and carry 3—6 times 1 is 6 and 3 are 9.

Thus we have 96 standing under 99.

Subtract 96 from 99—the remainder is 3.

Bring down the next and last figure in the dividend, viz. 2, which makes 32.

How many times 16 in 32?

The Table tells you twice 16 in 32.

Place 2 in the quotient, and multiply 16 by 2.

Twice 6 are 12—2 and carry 1—Twice 1 is 2 and 1 is 3.

Thus we have 32 standing under 32.

Subtract 32 from 32 and 0 remains—place two periods under 32, as you see on the Card.

KEY TO CARD No. 23.

The figures in our quotient amount to 4962, which is the answer to the question.

How many times 16 in 79392? Answer, 4962 times.

If 16 ounces make 1 pound, then 32 ounces will make 2 pounds; because we can have twice 16 in 32.

Forty-eight ounces make 3 pounds; because we can have 3 times 16 in 48.

Sixty-four ounces make 4 pounds; because we can have 4 times 16 in 64.

Eighty ounces make 5 pounds; because we can have 5 times 16 in 80.

And 79392 ounces make 4962 pounds; because we can have 4962 times 16 in 79392.

Let the class write these observations several times on their slates. They will thereby obtain an idea of a part, and by degrees understand the whole.

As the spears of grass and herbs, imperceptibly make their daily growth; so our knowledge increases by small portions, till we become masters of many valuable arts.

LESSON 2.

If 48297 cents are to be divided between 17 boys, how many may each one have?

```
17)48297(2841
   34
   ---
   142
   136
   ---
     69
     68
     ---
      17
      17
      --
```

First.

I say how many times 17 in 48? twice; set 2 in the quotient, and multiply the divisor by 2—the product is 34, which place under 48; then subtract 34 from 48, and there remain 14—Bring down the next figure from the dividend, viz. 2, and place it on the right hand side of 14, which makes 142.

Second.

How many times 17 in 142? by the Ta-

KEY TO CARD No. 23.

ble I find 8 times; set 8 in the quotient, and multiply 17 by 8—place the product under 142—subtract, and 6 remain.

Now bring down the next figure 9 from the dividend, and place it on the right of 6, makes 69.

Third.

How many times 17 in 69? 4 times; set 4 in the quotient, and multiply the divisor 17 by 4—place the product under 69—subtract it from 69 and there remains 1—to the right of this 1, bring down 7 the last figure in the dividend, makes 17.

Fourth.

I say 17 in 17—once—set 1 in the quotient, and say once 7 is 7—once 1 is 1 makes 17 to place under 17—subtract, and 0 remains—place your periods under 17, and the lesson is done.

Answer, 2841 cents for each boy.

LESSON 3.

In 98688 hours, how many days?

Note.—Twenty-four hours make one day.

```
24)98688(4112
   96
   --
   .26
    24
   ---
    .28
     24
    ---
     .48
      48
      --
```

First.

See how many times 24 are in 96.—In order to guess at the number of times, find how many times the first figure in the quotient is contained in the first figure of the dividend, that is, how many times 2 in 9? 4 times—therefore set 4 in the quotient, and multiply the divisor 24 by 4.

Place the product under 98—subtract—the remainder will be 2—bring down the next figure of the dividend, 6, to the right side of the 2, makes 26.

Second.

How many times 24 in 26? once—set 1 in the quotient, and multiply the divisor 24 by 1—once 4 is 4—once 2 is 2—place this product under 26—subtract—the remainder is again 2 as before—to the right side of this remainder 2, place the next figure in the dividend, 8, makes 28.

Third.

How many times 24 in 28? once—place 1 in the quotient and multiply the divisor again by 1—place the product under 28—subtract—the remainder is 4—to the right side of this remainder 4, set the next and, last figure of the dividend, 8—this makes 48.

Fourth.

How many times 24 in 48? twice—set 2 in the quotient, and multiply 24 by 2—set the product under 48—subtract—0 remains—place two periods under 48—the task is done. The quotient is the answer, 4112 days.

Here we find that 24 is contained 4112 times in 98688.

LESSON 4. *See Card* 24, *for proof.*

Divide 418392 Dollars between 78 men, what is each man's share?

```
78)418392(5364
   390
   ———
    283
    234
    ———
     499
     468
     ———
      312
      312
      ———
       ··
```

In the first place see how many times 78 in 418—take the first figure of the Divisor and the two first of the Dividend, and see how many times 7 in 41—I can have 5 times 7 in 35—by this I find that 5 may be safely set in the quotient.

Now multiply 78 by 5 and place the product under 418—subtract—the remainder is 28. Bring down the next figure of the dividend, 3—set it on the right side of 28, makes 283.

Second.

How many times 78 in 283? In order to guess at the number of times, say how many times 7 in 28—4 times; but as the unit figure in the divisor is a high number, viz. 8, I will make an allowance of 1 and say only 3 times.

KEY TO CARD No. 23.

Set 3 in the Quotient and multiply the divisor 78 by 3—Place the product under 283—subtract—the remainder is 49—to the right of this remainder set the next figure of the dividend, 9, makes 499.

Third.

How many times 78 in 499? how many times 7 in 49 for a guess—7 times; but as the unit figure in the divisor is great, make an allowance of 1 and say 6 times.

Set 6 in the Quotient and multiply the divisor 78 by 6—Set the product under 499—subtract—the remainder is 31; to the right side of this remainder, bring down the next and last figure of the dividend, viz. 2—this makes 312.

How many times 78 in 312? how many times 7 in 31—4 times and several over; the[illegible]re venture to set 4 in the quotient.

Multiply the divisor 78 by 4—set the product under 312—subtract—the remainder is 0—set three periods under 312 and the lesson is ended,

We find in the quotient 5364, which is the number of dollars for each man or answer.

Note.—When the remainder is as great, or greater than the divisor, the quotient figure must be augmented.

LESSON 5. *See Card* 24, *for proof.*

Divide 651744 by 96. *First.*

```
96)651744(6789
   576
   ---
   .757
    672
    ---
    .854
     768
     ---
     .864
      864
      ---
      ...
```

How many times 96 in 651?—how many times 9 in 65—7 times; but make an allowance of 1 and say 6 times—set 6 in the quotient and multiply the divisor 96 by 6.

Set the product under 651—subtract—the remainder is 75—bring down the next figure 7 from the dividend to the right side of 75—this makes 757.

Second.

How many times 96 in 757?—to make

a guess say how many times 9 in 75 ?—8 times—make an allowance of 1 and say 7 times—set 7 in the quotient and multiply the divisor 96 by 7.

Set the product under 757—subtract—the remainder is 85—Bring down the next figure 4 from the dividend to the right side of 85—this makes 854.

Third.

How many times 96 in 854 ? to make a guess say how many times 9 in 85—9 times; but allow 1 and say 8 times; set 8 in the quotient and multiply 96 by 8.

Set the product under 854—subtract—the remainder is 86—bring the next and last figure 4 from the dividend, set it on the right of 86, this makes 864.

[illegible]rth.

How many times 96 in [illegible] say 9 times—set 9 in the quotient and multiply the divisor 96 by 9—set the product under 864—subtract—the remainder is nothing—the quotient or answer is 6789.

LESSON 6. *See Card* 24, *for proof.*

Divide 977724 by 99.

```
99)977724(9876
   891
   ----
   .867
    792
    ----
    .752
     693
     ----
     .594
      594
      ----
      ...
```

First.

How many times 99 in 977? to make a guess say how many times 9 in 97—it will be contained 10 times; but allow 1 and say 9 times—set 9 in the quotient and multiply 99 by 9—place the product under 977—subtract—the remainder is 86. Bring down the next 7 from the dividend to the right side of 86 makes 867.

Second.

How many times 99 in 867? to make a guess say how many times 9 in 86—it will be 9 times; but make an allowance of 1 and say 8 times—set 8 in the quotient and multiply 99 by 8.

Place the product under 867—subtract—the remainder is 75—bring down the next figure 2 from the dividend to the right side of 75 makes 752.

Third.

How many times 99 in 752? seek how many times 9 in 75—it is contained 8 times; but allow 1 and say 7 times.

Multiply 99 by 7—place the product under 752—subtract—the remainder is 59—bring down the next and last figure 4 from the dividend to the right side of 59—this makes 594.

Fourth.

How many times 99 in 594? seek how many times 9 in 59—6 times 9 are 54—set 6 in the quotient and multiply 99 by 6.—Place the product under 594—subtract—the remainder is nothing—place three periods under 594.

The quotient or answer is 9876.

LESSON 7. *See Card* 24, *for proof.*

Divide 34615 by 182.

```
182)34615(190
    182
    ----
    1641
    1638
    ----
    ...35
```

First.

How many times 182 in 346? seek how many times 18 in 34—one—set 1 in the quotient—multiply 182 by 1—place the product under 346—subtract—the remainder is 164.

Bring the next figure 1 from the dividend to the right side of 164, makes 1641.

Second.

How many times 182 in 1641? look at the Table under 18, and see how many times 18 in 164—the last number under 18 is the place to begin to count upwards—the first number less than 164 is the guide to guess by, that is, 162—opposite 162 stands 9 times—then place 9 in the quotient.

KEY TO CARD No. 23.

Multiply the divisor 182 by 9—place the product under 1641—subtract—the remainder is 3—bring down 5, the last figure in the dividend to the right side of 3 makes 35.

Third.

How many times 182 in 35—no times—set 0 in the quotient—call this 35 a remainder, a number undivided.

The quotient or answer is $190\frac{35}{182}$.*

LESSON 8. *See Card* 24, *for proof.*

Divide 64329 by 194.

```
194)64329(331
     582
    ----
     .612
      582
     ----
      .309
       194
      ----
       115
```

First.

How many times 194 in 643? To make a guess, say how many times 19 in 64? Look at the Table—begin at the last number under 19 and count upwards till you come to a number less than 64, say 57—opposite this stands 3—set 3 in the quotient and multiply the divisor 194 by 3.

Place the product under 643—subtract—the remainder is 61—bring down the next figure 2 from the dividend to the right side of 61, makes 612.

Second.

How many times 194 in 612? To make a guess, seek how many times 19 in 61—look at the Table—begin at the last number under 19, count up till you find a number less than 61—say 57 as before; opposite 57 stands 3—set 3 in the quotient.

Multiply the divisor 194 by 3—place the product under 612—subtract—the remainder is 30—bring down the next figure 9 from the dividend to the right side of 30, makes 309.

---

* If the dividend had been dollars, this remainder 35 should be reduced to cents and divided by 182.—If the dividend had been pounds Avoirdupois, the pounds must have been reduced to ounces, &c. then divided by 182.

KEY TO CARD №. 23.

Third.

How many times 194 in 309? To make a guess, say how many times 19 in 30—We readily know but one—set 1 in the quotient, and set once 194 under 309—subtract—the remainder is 115.

The quotient or answer is $331\frac{115}{194}$.

LESSON 9. See Card 24, for proof.

Divide 684,927 by 4300.

DIRECTIONS.

Cut off the two ciphers from the divisor and divide by 43.

Cut off as many figures from the right of the dividend, viz. 27.

Your dividend will then be 6849 to be divided by 43.

EXAMPLE.

```
43|00)6849|27(159
      43
      ---
      254
      215
      ---
      .399
       387
       ----
      .1227
```

The 27 cut off is a part of the remainder and must be placed on the right of 12, makes a remainder of 1227.

First.

How many times 43 in 68?—We know by reflecting a moment that it can be contained only once.

Set 1 in the quotient and place once 43 or one time 43 under 68—subtract—the remainder is 25—bring down the next figure 4 from the dividend, makes 254.

Second.

How many times 43 in 254?—To make a guess, seek how many times 4 in 25—though it is contained 6 times, allow 1 and say 5 times—set 5 in the quotient.

Multiply 43 by 5—place the product under 254—subtract—the remainder is 39—bring down the next figure 9 from the dividend to the right side of 39, makes 399.

KEY TO CARD No. 24.

Third.

How many times 43 in 399?—To make a guess, seek how many times 4 in 39—we know that 9 times 4 are contained in 36 and can venture to place 9 in the quotient.

Multiply 43 by 9—place the product under 399—subtract—the remainder is 12; and to this remainder must be annexed 27, the two figures cut off the dividend—this number 27 being annexed, will make a remainder of 1227.

The quotient or answer is $159\frac{1227}{4300}$.

LESSON 10.

Divide 1,288,241 by 5600.

DIRECTIONS.

Cut off the two ciphers in the divisor, and as many figures in the dividend, then divide by 56.

EXAMPLE.

```
56|00)12882|41(230
        112
       -----
       .168
        168
       -------
        ...241
```

First.

How many times 56 in 128?—to make a guess, seek how many times 5 in 12—we know it will be twice.

Set 2 in the quotient and multiply 56 by 2—place the product under 128—subtract—the remainder is 16—bring down the next figure *8* from the dividend to the right side of 16, makes 168.

Second.

How many times 56 in 168?—Say how many times 5 in 16—we easily perceive it is contained 3 times—set 3 in the quotient.

Multiply 56 by 3—set the product under 168—subtract—nothing remains—bring down the 2.

Third.

How many times 56 in 2?—we cannot have 56 in 2, therefore set 0 in the quotient.

Now the 2 is a part of the remainder—bring the 41, which was cut off the dividend, to the right side of 2, and it makes a remainder of 241.—The quotient or answer is $230\frac{241}{5600}$.

KEY TO CARD No. 24.

LESSON 11.

Divide 8,123,187 by 346.

```
346)8123187(23477
     692
     ----
     1203
     1038
     ----
      1651
      1384
      ----
       2678
       2422
       ----
        2567
        2422
        ----
Rem.     145
```

First.

How many times 346 in 812—seek how many times 3 in 8—say twice—set 2 in the quotient and multiply 346 by 2.

Place the product under 812—subtract—the remainder is 120—bring down the next figure 3 from the dividend to the right side of 120, makes 1203.

Second.

How many times 346 in 1203—seek how many times 3 in 12—though it is 4 times, allow one and say 3 times.

Set 3 in the quotient and multiply 346 by 3—place the product under 1203—subtract—the remainder is 165—bring down the next figure 1 from the dividend to the right side of 165, makes 1651,

Third.

How many times 346 in 1651 ?—Seek how many times 3 in 16—it is 5 times—but allow one and say 4 times.

Set 4 in the quotient and multiply 346 by 4—place the product under 1651—subtract—the remainder is 267—bring down the next figure 8 from the dividend, makes 2678.

Fourth.

How many times 346 in 2678 ?—Seek how many times 3 in 26—though 8 times, yet allow one and say 7 times.

Set 7 in the quotient and multiply 346 by 7—place the product under 2678—subtract—the remainder is 256—bring down the next and last figure 7 from the dividend, makes 2567.

KEY TO CARD No. 24.

Fifth.

How many times 346 in 2567? seek how many times 3 in 25—8 times but allow one and say 7 times.

Set 7 in the quotient and multiply 346 by 7—place the product under 2567—subtract—the remainder is 145.

The quotient or answer is 23477$\frac{145}{346}$.

LESSON 12.

Divide 123,456,789 by 123.

```
123)123456789(1003713
    123
    ———
    ...456
       369
       ———
       .877
        861
        ———
        .168
         123
         ———
         .459
          369
          ———
          .90
```

First.

How many times 123 in 123?—we readily say one—set 1 in the quotient.

Multiply 123 by 1—the product is 123—place this product under the number 123 in the dividend—subtract—there remains 0—bring down the next figure 4 from the dividend.

Second.

How many times 123 in 4?—not one; set 0 in the quotient—bring down the next figure 5; it makes 45.

Third.

How many times 123 in 45?—not one; set 0 in the quotient—bring down the next figure 6; it makes 456.

Fourth.

How many times 123 in 456? 3 times—set 3 in the quotient—Multiply the divisor 123 by 3—place the product under 456—subtract—the remainder is 87—bring down the next figure 7; it makes 877.

Fifth.

How many times 123 in 877? To make a guess, say 12 in 87—7 times—place 7 in the quotient.—Multiply the divisor 123 by 7—place the product under 877—subtract—the remainder is 16—bring down the next figure 8; it makes 168.

Sixth.

How many times 123 in 168? one—set 1 in the quotient. Multiply and subtract—the remainder is 45—bring down 9 the last figure in the dividend; it makes 459.

Seventh.

How many times 123 in 459? seek how many times 12 in 45—3 times—set 3 in the quotient.—Multiply the divisor 123 by 3—place the product under 459—subtract—the remainder is 90.

The quotient or answer is $1{,}003{,}713\frac{90}{123}$ which number, in words, will read thus, One million three thousand seven hundred and thirteen, and ninety, one hundred and twenty-threes.

Note.—The three following questions may be wrought by Short Division, if you cut off the cipher in the divisor, and the right hand figure in the dividend.

Although this mode of cutting off ciphers, will sometimes expedite business; yet it is not advisable except when the calculator understands his *problem*, and is master of the subject then under consideration.

LESSON 13.

In 78,433 shillings, how many pounds?

2|0)7843|3
Answer, 3921£. 13*s*.

Here cut off the 0 in the divisor 20, and the right hand 3 in the dividend, then divide 7843 by 2.

How many times 2 in 7? 3 times and 1 over; set 3 under the 7. One over carry to the left side of 8 makes 18—2 in 18—9 times; set 9 under 8—2 in 4—twice; set 2 under the 4. Then 2 in 3—once and 1 over—set 1 under the 3 and carry the 1 over to the left side of the 3 cut off, which will make 13 shillings for a remainder.

This gives a quotient number, Three thousand nine hundred and twenty-one pounds thirteen shillings, for an answer, or thus, 3921$\frac{13}{20}$.

LESSON 14.

If 40 rods make 1 furlong, I wish to know how many furlongs are in 98643 rods?

4|0)9864|3

Answer, 2466 fur. 3 rods.

How many times 4 in 9? twice, and 1 over; set down 2 under 9 and carry 1 to the left side of 8 makes 18—How many times 4 in 18? 4 times and 2 over; set 4 under 8 and carry 2 to 6 makes 26—How many times 4 in 26? 6 times and 2 over; set 6 under 6 and carry 2 to 4 makes 24—How many times 4 in 24? 6 times; set 6 under 4.

The quotient is 2466, and the figure cut off the dividend, is $\frac{3}{40}$ of a furlong, or 3 rods remaining.

LESSON 15.

Sixty seconds make 1 minute. How many minutes in 39645 seconds?

6|0)3964|5

Answer, 660 m. 45 sec.

How many times 6 in 39?—6 times and 3 over—6 in 36? 6 times—6 in 4? 0, but 4 remains to be placed on the left side of the 5 cut off—this makes 45 seconds for a remainder, or $\frac{45}{60}$ of a minute.

The Quotient is 660 and 45 the Remainder.

Note.—When the Remainder is less than the Divisor, it is a sign that the work is correct; but if the Remainder happen greater than the Divisor, the work is wrong.

Let us prove a few Lessons in Long Division, by Multiplication.

RULE.

Multiply the Divisor and Quotient together, the Product will be like unto the Dividend.

If there be a Remainder, add it to the Product.

KEY TO CARD No. 24.

For *examples* take the six following Lessons on Card No. 23, and right hand page of Card 24.

LESSON 4.—*Page* 153.

The Quotient is,	5364
The Divisor,	78
	42912
	37548
Proof,	418392

LESSON 5.—*Page* 154.

The Quotient is,	6789
The Divisor,	96
	40734
	61101
Proof,	651744

LESSON 6.—*Page* 155.

The Quotient is,	9876
The Divisor,	99
	88884
	88884
Proof,	977724

LESSON 7.—*Page* 156.

The Divisor is,	182
The Quotient,	190
	16380
	182
Remainder,	35
Proof,	34615

In this Lesson 7th, take the Divisor for a Multiplicand, because the Quotient 190 has a cipher at the right; which cipher may be omitted in Multiplication, and only annexed in the place of units.

LESSON 8.—*Page* 157.

The Divisor is,	194
The Quotient,	331
	194
	582
	582
Remainder,	115
Proof,	64329

LESSON 9.—*Page* 158.

The Quotient is,	159
The Divisor,	4300
	47700
	636
Remainder,	1227
Proof,	684927

The ciphers are to be omitted in Multiplication, and added in the place of units and tens.

END OF PART SIXTH.

INTRODUCTION TO ARITHMETIC.

PART VII.

CONTAINING,

COMPOUND DIVISION, ARITHMETICAL CHARACTERS,
AND
DECIMALS.

COMPOUND DIVISION.

KEY TO CARD No. 25.

LESSON 1.

Divide £784 16*s.* 4*d.* between 4 men.

	£.	*s.*	*d.*
4)	784	16	4
	196	4	1

Pounds.

Four in 7—1 and 3 over—4 in 38—9 and 2 over—4 in 24—6 times.

Shillings.

Four in 16—4 times.

Pence.

Four in 4—1.

Quotient in words, One hundred and ninety-six pounds four shillings and one penny. This is each man's part.

LESSON 2.

Divide £ 1454 19*s.* between 8 men.

	£.	*s.*	*d.*	*q.*
8)	1454	19	0	0
	181	17	4	2

Pounds.

How many times 8 in 14? 1 and 6 over—How many times 8 in 65? 8 and 1 over—How many times 8 in 14? 1 and 6 over to carry to the shillings.

KEY TO CARD No. 25.

Shillings.

Six pounds over make 120*s.* and 19 make 139—How many times 8 in 139? 17 and 3 over I carry to the pence.*

Pence.

Three shillings over I carried make 36 pence—How many times 8 in 36? 4 times and 4 over I carry to the farthings.

Farthings.

Four pence over I carried make 16 farthings—How many times 8 in 16? 2.

Answer, £ 181 17 4 2.

LESSON 3.

Divide £ 1173 12*s.* 9*d.* by 12.

	£.	*s.*	*d.*	*q.*
12)	1173	12	9	0
	97	16	0	3

Pounds.

How many times 12 in 117? 9 and 9 over—How many times 12 in 93? 7 and 9 over I carry to the shillings.

Shillings.

Nine pounds over I carried make 180*s.* and 12 make 192. How many times 12 in 192? 16.

Pence.

Twelve in 9—0—carry 9 to the farthings.

Farthings.

Nine pence I carried make 36 farthings—How many times 12 in 36? 3.

Answer, £ 97 16 0 3.

LESSON 4.

If 19 yards of broadcloth cost £ 35 12 6, what is that a yard?

---

* Set 139 shillings on some part of your slates for a memorandum, and divide by 8, as in Short Division. Set the quotient 17 in the place of shillings, and carry the 3 over, to the pence.

KEY TO CARD No. 25.

```
   £.  s.  d.
19)35  12   6(1£.
   19
   —
   16
   20
   ——
19)332(17s.
   19
   ——
   142
   133
   ———
   ..9
    12
   ———
19)114(6d.
   114
   ——
   ...
Ans. £1  17  6
```

Directions for the calculation of Lesson 4.

Place the £35 12s. 6d. on your slates as you see it on the Card, with 19 before it for a divisor—Then seek how many times 19 in 35—say 1; set 1 off at the right hand for a quotient; this is 1 pound, because you can have once 19 in 35.

Now multiply 19 the divisor, by 1 and place the product under 35—subtract—the remainder is 16—This is 16 pounds to be multiplied by 20 to bring it into shillings, and the 12s. must be added in the product, which will make 332s.

Thus, 0 times 6 is 0, but 2 in the 12s. makes 2; set 2 in the place of units.

Then, twice 6 are 12, and 1 in the 12s. above makes 13; set 3 in the place of tens—carry 1.

Then, twice 1 makes 2 and 1 I carried makes 3; set another 3 in the place of hundreds. Thus you have for a product, 332s.

How many times 19 in 332? First seek how many times 19 in 33? say 1—place 1 off at the right for a quotient—multiply 19 by 1—place the product under 33—subtract—the remainder is 14.

Bring down the 2 to the right side of 14, makes 142—seek how many times 19 in 142—7 times—place 7 on the right of 1 in the quotient. This makes 17s.

Now multiply 19 by 7—place the product under 142—subtract—the remainder is 9s. to be reduced to pence.

Multiply 9 by 12, the number of pence in a shilling, and bring in the 6d. of the given sum above, makes 114 pence.

KEY TO CARD No. 25.

Again; how many times 19 in 114? 6 times—place 6 off at the right for a quotient—this is 6 pence—Multiply 19 by 6—place the product under 114—subtract, and nothing remains,

Recapitulation.

In the first quotient you had 1 pound; in the second, 17 shillings, and in the third, 6 pence.

These make for an answer, £ 1 17 6.

LESSON 5.

If 23 barrels of pork cost £ 179 17 7, what is that a barrel?

```
  £.  s.  d.
23)179 17  7(7 £.
   161
   ———
   .18
    20
   ———
23)377(16s.
   23
   ———
   147
   138
   ———
   ..9
    12
   ———
23)115(5d.
   115
   ———
   ...
```

Pounds.

How many times 23 in 179? 7 times—place 7 in the quotient for pounds.

Multiply 23 by 7—place the product under 179—subtract—the remainder is 18 pounds to be reduced to shillings, to which add the 17*s.* in the given sum, as in Lesson 4. This reduction will make 377*s.*

How many times 23 in 377? seek first how many times 23 in 37—1; set 1 in the quotient.

Multiply 23 by 1—place the product under 37—subtract—the remainder is 14—bring down the 7 makes 147.

How many times 23 in 147? 6 times—place 6 in the quotient—this makes 16*s.*

Multiply 23 by 6—place the quotient under 147—subtract—the remainder is 9*s.* to be reduced to pence; multiply 9 by 12, the number of pence in a shilling, and add

KEY TO CARD No. 25.

to the product the 7 pence in the given sum above: this operation makes 115 pence.

Now, how many times 23 in 115? 5 times—place 5 in the quotient; this makes 5 pence. Multiply 23 by 5—place the product under 115—subtract—the remainder is 0.

Recapitulation.

Your first quotient was £7; the second 16*s.* and the third *5d.*—making in the whole, for an answer, £7 16 5.

LESSON 6.

Bought 26 watches for £239 4 0, what did each one cost?

```
    £.   s.  d.
26)239   4   0(9£.
   234
   ———
   ..5
    20
   ———
26)104(4s.
   104
```

Pounds.

How many times 26 in 239? 9 times—set 9 in the quotient for pounds; multiply 26 by 9—place the product under 239—subtract—the remainder is £5 to be multiplied by 20 to reduce it into shillings, and at the same time add in the 4 shillings in the given sum, which makes 104*s.*

Shillings.

How many times 26 in 104?—4 times—place 4 in the quotient for shillings and multiply 26 by 4—place the product under 104—subtract—nothing remains.

Thus you have in the first quotient £9, and in the second 4*s.*: making for an answer £9 4*s.* the price of each watch.

KEY TO CARD No. 25.

LESSON 7.

Divide £ 486 15*s.* between 33 men, what is each man's part?

Pounds.

```
  £.  s.
33)486 15(14£.
   33
   ——
   ·156
    132
   ———
   .24
    20
   ——
33)495(15s.
   33
   ——
   165
   165
   ———
   ...
```

How many times 33 in 48?—1; set 1 in the quotient—multiply 33 by 1—place the product under 48—subtract—the remainder is 15; bring down the 6 makes 156.

How many times 33 in 156?—4 times—set 4 in the quotient makes 14 pounds—multiply 33 by 4—place the product under 156—subtract—the remainder is £ 24 to be reduced into shillings and added to the 15*s.* in the given sum, which makes 495*s.*

How many times 33 in 49?—1—place 1 in the quotient for shillings—multiply 33 by 1—place the product under 49—subtract—the remainder is 16—bring down the 5 makes 165.

How many times 33 in 165?—5 times—place 5 in the quotient which makes 15 for shillings—multiply 33 by 5—place the product under 165—subtract—the remainder is nothing.

RECAPITULATION.

The first quotient was £ 14, the second is 15*s.*, which make for an answer £ 14 15*s.*

LESSON 8.

A number of benevolent Gentlemen, visiting the school, say to the Teacher, "Here is a sum of £ 566 7*s.* to be divided between 47 of your best boys for the procurement of books:" What sum will each boy have?

KEY TO CARD No. 25.

£. s.
47)566 7(12£.
47
.96
94
£2 7s.
20
47)47(1s.
.47
..

How many times 47 in 56?—1—place 1 in the quotient for pounds—multiply 47 by 1—set the product under 56—subtract—the remainder is 9—bring down the other 6, makes 96.

How many times 47 in 96?—2—set 2 in the quotient, makes £12—multiply 47 by 2—place the product under 96—subtract—the remainder is £2 and 7*s.* in the given sum, make £2 7*s.* or 47*s.*

How many times 47 in 47? We know it can be contained 1 time and nothing remains; therefore the quotient in shillings is 1—The quotient in the pounds is £12, and in the shillings 1; consequently the answer is £12 1*s.*

LESSON 9.

Eighty-nine industrious boys hoed garden and pruned fruit trees, till their wages amounted to £28 3 8—They wished to divide the sum and purchase quills, ink, and paper: What was each one's share?

£. s. d.
89)28 3 8
20
89)563(6s.
534
.29
12
89)356(4d.
356

Pounds.

As you cannot have 89 in 28, therefore multiply by 20 to reduce the pounds into shillings, and add the 3 shillings of the given sum, which makes 563*s.*

How many times 89 in 563?—6—place 6 in the quotient for shillings—multiply 89 by 6; set the product under 563—subtract—The remainder is 29*s.* Multiply 29 by 12 to reduce it into pence, and add the 8 pence of the given sum, which makes 356 pence.

KEY TO CARD No. 25.

How many times 89 in 356?—4; set 4 in the quotient for pence—multiply 89 by 4—place the product under 356—as the two numbers are equal, subtraction is needless.

The answer is £ 0 6*s.* 4*d.*

How to find the price of *one* pound, *one* yard, *one* bushel, &c., when fractions are contained in the whole quantity; as, 34¼ pounds, 56½ yards, 77¾ bushels, &c.

RULE.

1. Multiply the quantity by 4 for a divisor.
2. Multiply the price by 4 for a dividend.
3. The quotient will be the answer.

LESSON 10.

EXAMPLE.

If 34¼ pounds of butter cost £ 2 19 11 1, what is that a pound?

Here the quantity is	34¼ pounds,	
Multiplied by	4	
The divisor is	137 quarters of pounds.	
The price is	£ 2 19 11 1	
Multiplied by	4	
The dividend is	£ 11 19 9 0	

Now proceed and divide £11 19 9, by 137, the quotient will be the answer, or the price of one pound.

£. *s.* *d.* 137)11 19 9 20	As you cannot have 137 in 11£—reduce it to shillings and add the 19*s.* which makes 239*s.*
137)239(1*s.* 137	One hundred and thirty-seven is contained 1 time in 239 and 102 remain.
102 12	Reduce this remainder into pence, and add the 9*d.* which makes 1233*d.*
137)1233(9*d.* 1233	One hundred and thirty-seven is contained exactly 9 times in 1233.

KEY TO CARD No. 25.

RECAPITULATION.

The first quotient is 1 shilling and the second is 9 pence; which make the answer £ 0 1*s.* 9*d.* for the price of each pound.

See remarks after Lesson 12.

LESSON 11.

Bought 56¼ yards of calico for £ 9 8 4, what is that a yard?

```
   In this case          56¼ is the quantity.
   Multiplied by          4  for a divisor.
                        ----
   The divisor is       226 quarters of yards.
The price is       £ 9  8  4
Multiplied by               4 for a dividend.
                   -----------
```

The dividend is £ 37 13 4 a quadruple sum from the first.

Proceed and divide this sum by 226. The quotient will be the answer.

```
     £.  s.  d.
 226)37  13   4
     20
    ----
226)753(3s.
    678
    ----
    .75s. 4d.
     12
    ----
226)904(4d.
    904
    ----
    ...
```

In this Lesson I find that 226 cannot be contained in £37, therefore reduce the pounds to shillings and bring in the 13 shillings, which make 753*s.*

Divide this sum by 226—the quotient is 3*s.* and there remain 75*s.* and 4*d.* over, to be reduced into pence, which makes 904*d.*—Divide this by 226—the quotient is 4*d.*

RECAPITULATION.

The first quotient is 3*s.*—the second, 4*d.*—consequently the answer is £ 0 3 4.

LESSON 12.

If 77¾ bushels of salt cost £ 34 0 3 3, what is that a bushel?

KEY TO CARD No. 25.

The quantity is	77¾ bushels.
Multiplied by	4
The divisor is	311 quarters of bushels.
The price is	£34 0 3 3
Multiplied by	4

The dividend is £136 1 3 0 a quadruple sum from the first price.

Now proceed and divide this sum by 311, the quadruple sum of the quantity; the quotient will be the answer.

```
     £.  s. d.
311)136  1  3
     20
   ------
311)2721(8s.
    2488
    ----
    .233
      12
    ----
311)2799(9d.
    2799
```

Three hundred and eleven cannot be contained in 136, therefore reduce the pounds, 136, into shillings, and add the 1 shilling above, which makes 2721*s*.

Divide this sum by 311, the quotient is 8*s*. and the remainder 233*s*.

Reduce this remainder into pence, and add the 3*d*. above, which makes 2799*d*.—Divide this number by 311—The quotient is 9*d*.

The answer to the question is £0 8*s*. 9*d*.

REMARKS.

NOTE 1. When multiplying the 34¼ pounds by 4, in Lesson 10, I say 4 times 4 are 16 and the one fourth makes 17—7 and carry 1—then 4 times 3 are 12 and 1 is 13, which makes 137 for a divisor. This augments the *quantity*, and makes it 4 times greater than at first.

2. Then I multiply the price £2 19 11 1 by 4, as in Compound Multiplication, which multiplying makes a sum of £11 19 9. This also augments the *price*, and makes *it* 4 times greater than at first, or a quadruple sum from the first.

3. In multiplying 56¼ by 4 in Lesson 11, I say, 4 times 6

are 24 and the two fourths in the fraction make 26—6 and carry 2, &c.

4. When multiplying 77¾ of Lesson 12, I say, 4 times 7 are 28, and the three fourths in the fraction make 31—1 and carry 3, &c.

5. Multiplying the *quantity* by 4, and multiplying the *price* by 4, keep the numbers in proportion; as in the following example.

Suppose we divide 6 by 2, the quotient is 3.

Now multiply the divisor 2, by 4, it makes 8; and multiply the dividend 6, by 4, it makes 24.

Divide 24 by 8, the quotient is 3, the same as when dividing 6 by 2.

How to find the price of one pound, when the price is given of one hundred weight or 112 *pounds.*

RULE.

Divide the price of 112 pounds by 8—divide that quotient by 7, which makes a second quotient; then divide this second quotient by 2, and the third quotient will be the answer.

EXAMPLES.

LESSON 13.

If 1 hundred of iron cost 79*s.* 4*d.* what is that a pound?

NOTE.—It will make no difference to divide by 7 first and then by 8.

	s.	*d.*	*q.*
7)	79	4	
8)	11	4	
2)	1	5	
		8	2

First. Shillings.

Seven in 7—1—7 in 9—1 and 2 remain I carry to the pence.

Pence.

Two shillings I carried make 24 pence and 4 are 28—7 in 28—4.

Second. Shillings.

Eight in 11—1 and 3 over I carry to the pence.

Pence.

Three shillings over I carried make 36 pence and 4 make 40—How many times 8 in 40?—5.

KEY TO CARD No. 25.

Third. Shillings.

Two in one I cannot; but 1*s.* makes 12 pence and 5 are 17—two in 17—8 times and one over—1 penny makes 4 farthings—2 in 4—2 times.

Thus we find the answer to be 8*d.* 2*q.*

LESSON 14.

A merchant bought 5 hundred weight of lead for £14 11 8, what was that a pound?

	£.	*s.*	*d.*	*q.*
5)	14	11	8	
8)	2	18	4	
7)		7	3	2
2)		1	0	2
			6	1

First. Pounds.

Five in 14—2, and £4 over.

Shillings.

£4 over make 80*s.* and 11 are 91.

Five in 91—18 times and 1 over.

Pence.

One shilling over makes 12 pence and 8 are 20—5 in 20—4 times.

Second. Pounds.

Eight in 2—no times, but 2 pounds make 40*s.* and 18*s.* make 58*s.*

Shillings.

Eight in 58—7 times and 2 over.

Pence.

Two shillings over make 24 pence and 4 are 28—8 in 28—3 times and 4 over.

Farthings.

Four pence over make 16 farthings—8 in 16—2 times.

Third. Shillings.

Seven in 7—1.

Pence.

Seven in 3—0, but 3*d.* remain undivided.

Farthings.

Three pence remaining undivided, make 12 farthings and 2 are 14—7 in 14 twice.

Fourth. Shillings and Pence.

Two in 1—0, but 1*s.* makes 12*d.*—2 in 12—6 times; set 6 for pence.

KEY TO CARD No. 26.

Farthings.

Two in 2 farthings—1; set 1 for farthings. The answer is 6*d*, 1*q*. a pound.

Compound Division is proved by Compound Multiplication.

EXAMPLE.

Reverse the last lesson or question and say, "If 1 pound of Lead cost 6*d*. 1*q*., what will five hundred weight cost?"

£.	*s*.	*d*.	*q*.	£.	*s*.	*d*.	*q*.	
		6	1		7	3	2	
			2				8	
	1	0	2	2	18	4	0	
			7				5	
	7	3	2	£14	11	8	0	Proof.

FORM OF ARITHMETICAL CHARACTERS.

Equal to, marked thus,	=	Division, marked thus,	÷
Addition, - - - -	+	Proportion,	: :: :
Subtraction, - - -	—	Square, - - - - - -	⌉
Multiplication, - - -	×	Square Root, - - -	√

EXPLANATION.

= Two parallel lines denote *Equality*; as, 3*s*.=36 pence; that is, three shillings equal thirty-six pence.

+ A perpendicular and horizontal line forming a cross, signify *Addition*; as, 4+2=6. 3+2+4=9. Read thus, 4 more 2 equal 6. 3 more 2 more 4 equal 9.

— *A single dash denotes *Subtraction*; as, 7—2=5. 7—2—1=4. Read, 7 less 2 equal 5. 7 less 2 less 1 equal 4.

× Two lines forming a cross diagonally, signify *Multiplication*; as, 4×2=8. That is, 4 multiplied by 2 equals 8.

÷ A dash with two periods, one above, and one below the centre, signify *Division*; as, 12÷2=6. That is, 12 divided by 2 equals 6. An inverted *parenthesis* also denotes division.

---

* In this book, the dash is not used arithmetically till after division.

KEY TO CARD No. 26.

:: Four points set in the middle of four numbers, denote the numbers to be *proportional* to one another, in the *Rule of Three;* as 3 : 6 : : 12 : 24. That is, as 3 are : to 6 : : so are 12 : to 24.

¯| A Square signifies that the square of any number is required; as, ¯| 4=16; or the square of 4 equals 16.

√ This reversed figure seven, signifies that the Square Root of a number is required, as √16=4; that is to say, the Square Root of 16 equals 4, or is 4.

These characters are used to save written words, and to show when to add, subtract, multiply, or divide, without a tedious series of writing. The learners may copy them several times on their slates. See Card No. 26.

DECIMALS.

Having given a hint of *decimals* in Multiplication, I will now insert a few lessons to aid the learner in common business; but as the whole subject of fractions is tedious and little in use, shall give a view of the most necessary cases only.

What is a fraction?

It is some part of an integer; that is, some part of a whole number; as,

One fourth.	One half.	Three fourths.	Seven eighths.
$\frac{1}{4}$	$\frac{1}{2}$	$\frac{3}{4}$	$\frac{7}{8}$

Nineteen twentieths, &c. $\frac{19}{20}$

These are called vulgar fractions; and for ease, plainness, and despatch of business, decimals have been invented for a *substitute.* Therefore our first business will be to form fractions into decimals.

In order to understand ourselves, let us have a name for each part of the aforegoing fractions.

KEY TO CARD No. 26.

The upper number is called *Numerator;* and is made by a remainder after division.

The lower number is called, *Denominator;* and is the divisor in Division. Thus, divide 17 cents equally between 4 boys, each share is 4¼; that is, four and one fourth.

To turn fractions into decimals, observe the following

RULES.

1. Annex, that is, place on the right side of the *Numerator,* one or more ciphers, and call it a *Dividend.*

2. Take the lower number, the *Denominator,* for a divisor: The quotient will be the decimal required.

CASE 1.

LESSON. 1.

What is the decimal of ¼?	4)1.00(.25
The numerator is 1.	8
	—
Answer, .25 hundredths,	20
	20

REMARKS.

In decimal operations, Long Division is preferable to Short Division, on account of knowing where to place the dividing *point.* This point is the only difficulty to be met with in decimals. It is a period called *the separatrix,* to separate decimals from integers, and integers from decimals.*

When we shall readily know where to place this point, decimals will become as familiar as integers; and greatly expedite business in frequent instances.

To know how, and where to place this *point,* let us attend to a few particular rules.

DIVISION.

1. Count the decimal places in the dividend. Suppose them to be two as in lesson first.

2. Count the number of decimals in the divisor, if any, then begin at the right hand figure in the quotient, and

---

* *Integer* signifies a whole number; as, a pound, an ounce, a bushel, a gallon, &c. "The whole of any thing."

continue counting towards the left, till you have a number equal to the decimals in the dividend; there place the separatrix or point.

3. But if the number of figures in the quotient fall short, then prefix ciphers on the left till your counting is completed: there place the point.

4. When the dividend is less than the divisor, annex ciphers on the right according to discretion.

NOTE.—In forming fractions into decimals, we consider the *Numerator*, and *Denominator*, as two distinct whole numbers.

For instance, observe lesson first. We place 1 for a dividend, and 4 for a divisor. We then see that 4 cannot be contained in 1; therefore place a point and annex ciphers to the right of the point.

These ciphers show us how many decimal parts are contained in the dividend; and that the digit, 1, is considered as an integer.*

In the next place we proceed with Division; when done, begin to count and see where the point must be placed in the quotient. As there is no decimal place in the divisor of lesson 1, begin at the right hand of the quotient and count towards the left, till having a number equal to the decimal places in the dividend: then place our point as on the left side of .25 hundredths. This counting proves its being placed right at first.

LESSON 2.

What is the decimal of ½?

The numerator is 1. | 2)1.0(.5 || In this lesson it is neces-
The denominator is 2. | 1 0 || sary to annex one cipher

only; consequently there is but one decimal place in the dividend. And as there is but one figure in the quotient, the point must be placed on the left of that figure. Thus, .5 tenths.

---

* *Digit*, signifies any number under ten.

KEY TO CARD No. 26.

Note.—The separatrix or point, is in the place of units when reading decimals, and instead of reading units, tens, hundreds, &c. towards the left as in whole numbers, we begin with the point, calling it units, and read to the right.

EXAMPLES.

Call the point, units. .25 units, tens, hundreds: twenty-five hundredths. .5 units, tens: five tenths. .075 units, tens, hundreds, thousands: seventy-five thousandths.

LESSON 3.

What is the decimal of $\frac{3}{4}$?

4)3.00(.75 hundredths, the
2 8 answer.
—
.20
20

LESSON 4.

What is the decimal of $\frac{7}{8}$?

Answer, .875

8)7.000(.875
6 4
—
.60
56
—
.40
40

LESSON 5.

What is the decimal of $\frac{19}{20}$?

20)19.00(.95
18 0
—
.100
100
—
...

Ans. .95

LESSON 6.

Digression 1st.

What is the amount of .25 .5 .75 .875 and .95 of a pound?

Rule in Addition.

Begin at the period or units, and place tens under tens, hundreds under hundreds, &c. towards the right; then add as in whole numbers carrying at every ten.

.25 hundredths.
.5 tenths.
.75 hundredths.
.875 thousandths.
.95 hundredths.
—
3.325

Answer, £ 3.325

In words, Three pounds, and three hundred and twenty-five *thousandths* of a pound.

Or,

Three tenths, two hundredths, and 5 thousandths of a pound.

How shall we know where to place the decimal point in Addition?

RULE.

Count that number which has the most decimal places: then begin at the right of the amount and count as many towards the left; there place the point. The figures on the left of the point are whole numbers.

LESSON 7.

DIGRESSION 2nd.

How shall we find the value of £ 3.325 in pounds, shillings, and pence?

RULE.

Multiply the decimals by the denominations in pounds, shillings, and pence; the figures that happen on the left of the point, are whole numbers.

EXAMPLE.

```
            £ 3.325
                 20s. in a pound.
            ------
Shil.       6 .500
                 12d. in a shil.
            ------
Pence,      6 .000
      Ans. £ 3  6s.  6d.
```

Proof of Lessons 6 *and* 7, *by mental and practical calculation.*

			£.	s.	d.
$\frac{1}{4}$ or .25	of a pound	=	0	5	0
$\frac{1}{2}$ or .5		=	0	10	0
$\frac{3}{4}$ or .75		=	0	15	0
$\frac{7}{8}$ or .875		=	0	17	6
$\frac{19}{20}$ or .95		=	0	19	0
	Amount,		£ 3	6	6

Query.

What is the use of having several sums of money formed into Decimals?

The benefits arising are many and great: we can then make calculations with ease, by carrying at every ten as in whole numbers. For in all decimal operations, except Duodecimals, we carry at every ten.

LESSON 8. *Card* 27.

What is the decimal of $\frac{1}{12}$ of a pound?

```
12)1.000(.08333
    96
    ---
    .40
     36
    ---
    .40*
     36
    ---
    .40*
     36
     --
    . 4
```

---

* Ciphers added for Decimals.

KEY TO CARD No. 27.

REMARKS.

In the first place we fix the point and annex three ciphers to the 1 thus, 1.000

Then say, how many times 12 in 100? 8 times and 4 remain. Bring down the other cipher makes 40.

How many times 12 in 40? 3 times and 4 remain. Then annex a cipher to the remainder and mark it with an asterisk thus, 40*. Then proceed.

How many times 12 in 40? 3 times and 4 remain. Annex another cipher to the remainder and mark it as before.

Then how many times 12 in 40 again? 3 times and 4 remain; and in this manner 4 would remain continually without end.

We will therefore call this decimal a *surd*,† that is, a number which cannot be reduced to exactness.

Let this decimal be marked with the sign of more, thus, .08333+4

But whence came this 0 on the left side of the 8?

I will explain it: we had three places of decimals annexed to the 1; then we added two more marked with a star or asterisk; the whole make five decimal places in the dividend.

Now, the rule says, "If there be a deficiency of decimal places in the quotient, supply the defect by prefixing ciphers on the left."

Let us count the decimals in the quotient, beginning at the right: 3, 3, 3, 8: here are only four, but we ought to have five; because there are five decimal places in the dividend.

Then prefix a cipher on the left of 8 in the quotient, and place the separatrix or point on the left of the cipher.

To read this decimal, call the point units: then proceed to the right; "Tens, hundreds, thousands, tens of

---

† A decimal that comes to a close without a remainder, as in Lesson 4, may be called a finite decimal.

KEY TO CARD No. 27.

thousands, hundreds of thousands." "Eight thousand three hundred and thirty-three; *One hundred thousandths.*"

Answer in figures, .08333+4 of a pound, or in form of a vulgar fraction, thus, $\frac{8333}{100000}+4$

LESSON 9.

What is the decimal of $\frac{8}{15}$?

```
15)8.00000(.53333+5
   75
   ——
   .50
    45
    ——
    .50
     45
     ——
     .50
      45
      ——
      .50
       45
       ——
       .5
```

Remarks.

This decimal is also a *surd.*

The quotients of such fractions must be continued in proportion to the magnitude of the integer from which they proceed; that is to say, $\frac{8}{15}$ of a pound is a sum of greater value than $\frac{8}{15}$ of a farthing; and as decimals decrease towards the right, it is more needful to extend the decimals of a pound, than of an inferior denomination.

Five places of decimals are commonly sufficient for minuteness in most cases of importance; but for the sake of curiosity in some peculiar calculations, the operator may extend decimals to what length he please.

Note.—The remainder of a *surd* must be added in proof.

Copy the following on your slates, having reference at the same time, to the Table on page 185.

.1	One, *tenth.*
,12	Twelve, *hundredths.*
.123	One hundred and twenty-three, *Thousandths.*
,1234	One thousand two hundred and thirty-four, *Ten thousandths.*
,12345	Twelve thousand three hundred and forty-five, *One hundred thousandths.*
,123456	One hundred twenty-three thousand four hundred and fifty-six, *Millionths.*

KEY TO CARD No. 27.

Decimals may be read collectively or singly.

Collectively thus: One hundred twenty-three thousand four hundred and fifty-six, *Millionths.*

Singly thus: One tenth, two hundredths, three thousandths, four ten thousandths, five hundred thousandths, six millionths.

NUMERATION TABLE

IN DECIMALS.

Copy the Card on your slates.

Units.	Tenths.	Hundredths.	Thousandths.	Tens of Thousandths.	Hundreds of thousandths.	Millionths.
·	1	2	3	4	5	6

A CONCISE VIEW OF DECIMAL RULES.

1. *Addition.*

Count the decimal places in the greatest number of decimal figures of the sum to be added. Begin at the right of the sum total, and count as many towards the left for decimals.

2. *Subtraction.*

Let the decimal places in the remainder, be equal to the greatest number of decimals in either of the two numbers above singly considered.

3. *Multiplication.*

The number of decimal places in the product, must be equal to the whole of those in the two factors; and if figures are wanting in the product, prefix ciphers on the left, to supply the defect.

KEY TO CARD No. 27.

4. *Division.*

The number of decimal places in the *divisor* and *quotient* counted together, must be equal to those in the *dividend.*

NOTE 1. If decimal places be wanting in the dividend, annex so many ciphers as you please.

2. If there be decimal places wanting in the quotient, supply the defect by prefixing ciphers.

These Rules shall be more fully explained, when we work by them separately.

CASE 2.

To find the integral value of a decimal.

RULE.

Multiply the fraction by the *denominations* of the integer, and point off the decimal parts to the right; the left will be integers; as in Lesson 7.

LESSON 10.

How many cents in .25 of a dollar?

	.25 multiplied by 100
100 cents make 1 dollar,	100
Answer, 25 cents,	25.00

By what rule do we point off decimals in multiplication?

By counting the decimal places in both factors; that is in the multiplicand and multiplier: Then begin at the right of the product and count so many towards the left as were in the two factors; there place the point. The figures on the left are integers. See Rule 3.

NOTE.—If there be not so many figures in the product as are in the two factors, supply the defect by prefixing ciphers to the left hand.

EXAMPLE.

Multiply	.004	Here are three decimals in the upper factor, and there is one in the lower; therefore we must have four in the product.
By	.8	
Product,	.0032	

REMARKS.

It is of importance to know the place of the *decimal point;* because decimals *decrease* in a tenfold proportion towards the right, as whole numbers *increase* towards the left.

KEY TO CARD No. 27.

In the above example, if the cipher had not been prefixed, the number would read .032 "thirty-two *thousandths.*" Whereas the true number is "thirty-two *ten thousandths.*"

LESSON 11.

What is the value of .5 of a dollar in cents?

.5×100
100

Answer, 50.0 cents.

LESSON 12.

What number of shillings are in .75 of a pound?

20

Ans. 15.00*s.*

LESSON 13.

How many cents in .875 of a dollar.

.875
100

87.500
Answer, 87.5 cents.

In this result or product it may be observed that the fraction is five hundred *thousandths;* but that is the same as fifty hundredths, or five tenths.

LESSON 14.

In .8 of a dollar, how many cents?

.8
100

80.0
Answer, 80 cents.

LESSON 15.

In .75 of a shilling how many pence?

.75×12
12

Pence, 9.00
Answer, 9 pence.

LESSON 16.

How many shillings in .95 of a pound?

.95×20
20

Shillings, 19.00
Answer, 19 shillings.

LESSON 17.

What is the value of .8125 of a shilling?

.8125
12

Pence, 9.7500
4

Farthings 3.0000
Answer, 9*d.* 3*q.*

LESSON 18.

What is the proper quantity of .0625 of a hundred weight, or 112 pounds?

.0625
112.

1250
6875

Pounds, 7.0000
Answer, 7 pounds.

KEY TO CARD No. 21.

LESSON 19.

What number of pounds Avoirdupois are in .1875 of a hundred weight?

.1875
112.

3750
20625

Pounds, 21.0000
Answer, 21 pounds.

LESSON 20.

If 60 pounds of wheat make 1 bushel, how many pounds are in .75 of a bushel?

.75
60

Pounds, 45.00
Answer, 45 pounds.

LESSON 21.

What is the proper value of .790625 of a pound?

£ .790625
20*s.*

Shillings, 15.812500
12*s.*
Pence, 9.750000
4

Farthings, 3.000000
Answer, 15*s.* 9*d.* 3*q.*

Read the above question thus: "Seven hundred and ninety thousand six hundred and twenty-five *Millionths.*

LESSON 22.

What is the proper value of .1875 of a pound currency?

£ .1875
20*s.*

Shillings, 3.7500
12

Pence, 9.0000
Answer, 3*s.* 9*d.*

CASE 3.

LESSON 23.

Reduce 15*s.* 9*d.* 3*q.* to the decimal of a pound.

How shall we reduce quantities of several denominations, such as, shillings, pence & farthings; quarters, pounds, ounces, &c. to a decimal?

RULE.

1. Begin a column with the least denomination and proceed downwards to the greatest, thus,

Farthings,	3
Pence,	9
Shillings,	15
Ounces,	12
Pounds,	21
Quarters,	2

2. Let ciphers be ideally annexed as they really are in Lessons 3, 4, and 5.

3. Begin at the top and divide each number by its value in the next denomination; that is, farthings by 4, pence, by 12, shillings by 20, &c.

KEY TO CARD No. 28.

4. Place the quotient as a decimal part for each denomination next below. For instance, when dividing farthings, place the quotient on the right of pence. When dividing pence and the decimals annexed, place the quotient on the right of shillings, &c. The last quotient will be the decimal required.

OPERATION.

4 | 3.
12 | 9.75
20 | 15.8125(.790625
 | 140
.181
180
..125
120
..50*
40
100*

Answer, .790625 of a pound.

LESSON 24.

Reduce 12*s.* 6*d.* 3*q.* to the decimal of a pound.

4 | 3.
12 | 6.75
20 | 12.5625(.628125
 | 120
..56
40
162
160
..25

continued.

..25
20
.50*
40
100*
100

Answer, .628125

LESSON 25.

Reduce 9*d.* 3*q.* to the decimal of a shilling.

4 | 3.
12 | 9.75
.8125

Answer, .8125

LESSON 26.

Reduce 3*q.* to the decimal of a shilling.

4 | 3.
12 | 0.75
.0625

Answer, .0625

LESSON 27.

Reduce 3*s.* 6*d.* to the decimal of a dollar of 8*s.*

12 | 6.
8 | 3.5
.4375

Answer, .4375

LESSON 28.

Reduce 7*s.* 3*d.* to the decimal of a dollar of 8 shillings.

12 | 3.
8 | 7.25
.90625

Answer, .90625

KEY TO CARD No. 28.

LESSON 29.

Reduce 2*s.* 6*d.* to the decimal of a dollar of 6 shillings.

12|6.
6|2.5
.41666+4

Answer, .41666+4

Proof by Case 2.

.41666+4
6

Shillings, 2.50000
12

Pence, 6.00000

See Note under Lesson 9.

LESSON 30.

Reduce 3*s.* 9*d.* to the decimal of a dollar of 7*s.* 6*d.* Jersey currency.

12|9.
7.5|3.75(.5 Answer.
375

. . .

REMARKS.

1. As 7*s.* 6*d.* make a dollar, we must divide by it for our last divisor. And as it cannot be used in its present form, we reduce the 6*d.* to the decimal of a shilling, viz. .5 and annex this decimal to 7*s.* thus, 7.5

2. For placing the point in this answer, see *Division*, under Lesson 1.

LESSON 31.

Reduce 1*s.* 10*d.* 2*q.* to the decimal of a dollar Jersey currency.

4|2.
12|10.5
7.5|1.875(.25 Answer.
1 50

.375
375

LESSON 32.

I wish to prepare £ 25 17*s.* 6*d.* for a common multiplier in making out a tedious Return of Assessments.

What is the number required? Answer, £ 25.875

Directions.

Reduce the 17*s.* 6*d.* to the decimal of a pound, and place the 25 pounds on the left of the separatrix.

END OF PART SEVENTH.

INTRODUCTION TO ARITHMETIC,

PART VIII.

CONTAINING,

REDUCTION OF WEIGHTS AND MEASURES, DUODECIMALS, REGULATIONS OF OLD LINES, AND THE METHOD OF MAKING NATURAL RADIUS.

REDUCTION.

KEY TO CARD No. 28.

THIS Rule is used in reducing large denominations to small ones, as, pounds to shillings, pence, &c. called *Reduction descending*, or in reducing small denominations to large ones, as, farthings to pence, shillings, &c. called *Reduction ascending;* but these niceties are unworthy the attention of men in business: The main thing is to understand how to calculate with accuracy and despatch.*

We shall therefore attend to such lessons as will most probably happen in the common business of life; and study out those of amusement, when time, circumstances, and propriety will admit.

AVOIRDUPOIS WEIGHT.

16	drams, marked dr. make 1 ounce,	oz.
16	ounces make 1 pound,	lb.
28	pounds 1 quarter of a hundred weight,	qr.
4	quarters, or 112 lb. 1 hundred weight,	cwt.
20	hundred weight 1 ton,	T.
60	pounds 1 bushel of wheat in New-York,	B.

---

* *Despatch* is more modern than *dispatch*.

KEY TO CARD No. 28.

LESSON 1.

In 1440 lb. of wheat, how many bushels? Ans. 24 B.

DIRECTIONS.

1440÷60=24 for an answer.

That is, 1440 divided by 60 equals 24 for an answer.

6|0)144|0
24 B.

LESSON 2.

In 18000 lb. of wheat, how many loads at 20 bushels each? Ans. 15 loads.

18000÷60÷20=15 for an answer.

That is, 18000 divided by 60, divided by 20, equals 15 for an answer.

LESSON 3.

Bought 4 loads of wheat weighing as follows:

1 load,	-	1235 lb.
2	-	1245
3	-	1231
4	-	1242

6|0)495|3
82 33 lb.

How many pounds and bushels in the whole?

Answer, 4953 lb. or 82 B. 33 lb. over.

LESSON 4.

In 14 cwt. 2 qrs. 25 lb. how many lb.?

DIRECTIONS.

1. Multiply 14 by 4, the number of quarters in a hundred weight, and add the 2 qrs. in the given sum, makes 58 qrs.

2. Multiply this sum by 28, the number of pounds in a quarter, and add the 25 lb. of the given sum, which will make for an answer, 1649 lb.

14×4+2=58.

58×28+25=1649.

Read thus:

14 multiplied by 4 added to 2 equals 58.

58 multiplied by 28 added to 25 equals 1649.

OPERATION.

cwt.	*qrs.*	*lb.*
14	2	25
4		
58		
28		
489		
116		
1649		

LESSON 5.

Bring 1649 pounds into hundreds, quarters, and pounds.

Ans. 14 cwt. 2 qrs. 25 lb.

DIRECTIONS.

1649÷28=58 and 25 lb. over.

58÷4=14 and 2 qrs. over.

Read thus:

1649 divided by 28, equals 58 and 25 lb. over.

58 divided by 4, equals 14 and 2 qrs. over.

KEY TO CARD No. 28.

OPERATION.

```
28)1649(58 qrs.
   140
   ———
   .249
   .224
   ———
    .25 lb.
4)58
  14  2 qrs.
```

LESSON 6.

In 33152 ounces, how many hundred weight?

Ans. 18 cwt. 2 qrs.

33152÷16=2072 lb.
2072÷28=74 qrs.
74÷4=18 cwt. and 2 qrs. over. Read thus,

33152 divided by 16 equals 2072 lb.

2072 divided by 28 equals 74 qrs.

74 divided by 4 equals 18 and 2 qrs. over.

OPERATION.

```
16)33152(2072 lb.
   32
   ———
   .115
    112
    ———
   ..32
     32
    ———
     00
     lb.
28)2072(74 qrs.
   196
   ———
   .112
    112
    ———
    000
      qrs.
    4)74
      18 cwt. 2 qrs.
```

LESSON 7.

In 18 cwt. 2 qrs. how many ounces? Ans. 33152 oz.

DIRECTIONS.

18×4+2=74 qrs.
74×28=2072 lb.
2072×16=33152 oz.

OPERATION.

```
cwt. qrs.          qrs.
 18   2             74
  4                 28
 ——                ———
 74 qrs.           592
                  148
                  ————
                  2072 lb.
                    16
                 —————
                 12432
                 2072
                 —————
                 33152 oz.
```

KEY TO CARD No. 29.

LESSON 8.

Bought 4 hogsheads of tobacco weighing as follows.

	cwt.	qrs.	lb.
1 Hhd.	12	1	14
2 .	11	2	21
3 .	12	3	15
4 .	12	0	25
	49	0	19

What is the weight of the whole?

Answer, 49 cwt. 19 lb. or, 2 T. 9 cwt. 0 qr. 19 lb.

KEY TO CARD No. 29.

LESSON 9.

Take 12 cwt. 0 qrs. 25 lb. from 49 cwt. 0 qrs. 19 lb. how much remains?

Answer, 36 cwt. 3 qrs. 22 lb.

49 cwt. 0 qrs. 19 lb.—
12 0 25
=36 3 22

Read thus,

49 cwt. 0 qrs. 19 lb.
less
12 0 25
equals
36 3 22

Operation.

cwt.	qrs.	lb.
49	0	19
12	0	25
36	3	22

Addition and Subtraction.

In these Rules we carry at every 16 in the drams and ounces, at 28 in pounds, at 4 in quarters, and at 10 in hundreds; but if we wish to make tons, then carry at 20 in the hundreds.

LESSON 10.

If 49 cwt. 19 lb. of tobacco be transported on 4 waggons, what weight will each carry on an average?

Answer, 12 cwt. 1 qr. 4 lb. 12 oz.

	cwt.	qr.	lb.	oz.
4)	49	0	19	0
	12	1	4	12

In this operation we say 4 in 4? 1. 4 in 9? 2. and 1 cwt. over which make 4 quarters.

Then 4 in 4? 1. 4 in 19? 4 times and 3 over.

Three pounds make 48 ounces; 4 in 48? 12 times.

LESSON 11.

Forty-four seamen take in a prize 82 cwt. 2 qrs. 22 lb. of Indigo: What quantity will be left for the ship after giving each man 105 lb. 4 oz.?

Answer, 41 cwt. 1 qr. 11 lb.

Directions.

Reduce the 105 lb. into qrs. by 28, that is, 105÷28=3 and 21 lb. over, or 105 lb. 4 oz. equals 3 qrs. 21 lb. 4 oz.

Multiply this quantity by 11 and by 4, the product will be the same as if multiplied by 44, the number of men.

lb.
28)105(3 qrs.
84
—
21

cwt.	qrs.	lb.	oz.
	3	21	4
			11
10	1	9	12
			4
41	1	11	0

Thus 44 men will receive 41 cwt. 1 qr. 11 lb.; which quantity must be subtracted from the whole, viz. 82 cwt 2 qrs. 22 lb.

KEY TO CARD No. 29.

Operation.

A.	cwt.	qrs.	lb.
	82	2	22
	41	1	11
	41	1	11 for the ship.

In multiplying 3 qrs. 21 lb. 4 oz. we say,

11 times 4 are 44 oz. 44 ounces make 2 lb. 12 oz.; set 12 for ounces and carry 2 to the pounds.

Pounds.

Eleven times 21 are 231 and 2 we carried make 233 lb. 28 in 233? 8 times and 9 over; this makes 8 quarters and 9 pounds; set down 9 and carry 8 to the quarters.

Quarters.

Eleven times 3 are 33 and 8 we carried are 41. 41 quarters make 10 cwt. 1 qr.

Then we multiply 10 cwt. 1 qr. 9 lb. 12 oz. by 4: the product is 41 cwt. 1 qr. 11 lb. to be given to the 44 seamen.

Operation in words.

Ounces.

Four times 12 are 48: 48 ounces make 3 lb.; carry 3 to the pounds.

Pounds.

Four times 9 are 36 and 3 we carried make 39 lb. or 1 qr. 11 lb.; set down 11 and carry 1 to the quarters.

Quarters.

Four times 1 is 4 and 1 we carried makes 5: 5 quarters make 1 cwt. 1 qr.; set down 1 and carry 1 to the hundreds.

Hundreds.

Four times 10 are 40 and 1 we carried makes 41. Subtract this quantity from 82 cwt. 2 qrs. and 22 lb., the remainder will belong to the ship. See operation marked A.

Remarks.

The perplexity of boys in working the four last lessons, is a sufficient evidence of mismanagement during past ages.

It has been too fashionable to puzzle young beginners in arithmetic, with all the weights and measures when they are learning *Addition* and *Subtraction.*

Their minds are thereby overcharged with various, intricate, and unpleasing objects, before they are informed with a practical knowledge in figures.

The consequences of which have been, a loss of time, discouragement, and a forsaking of arithmetic.

It is hoped that these hints will serve to relieve ciphering classes in future, from so needless a burden.

LESSON 12.

Bought 157 barrels of sugar, weighing in gross, 363 lb. each: Tare, 27 lb. a barrel.

How many pounds neat?

N. B. Merchandise weighed in boxes, bags, barrels, &c. is called gross; but after the *tare*, that is, the weight of the boxes, bags, &c. is subtracted, the weight is called neat.

DIRECTIONS.

1. Multiply the number of barrels by the tare per barrel, the product will be 4239 for tare.

2. Multiply the number of barrels by the gross weight of each barrel, the product will be 56991 for the gross; subtract the tare from the gross, the remainder will be neat.

OPERATION.

157 barrels.	363 lb. gross.
27 lb. tare per barrel.	157 barrels.
1099	2541
314	1815
	363
4239 Amount of tare.	
	56991 gross.
	4239 tare.
	52752 neat.

TROY WEIGHT.

24 grains, marked gr. make	1 pennyweight.	pwt.
20 pennyweights,	1 ounce,	oz.
12 ounces,	1 pound,	lb.

KEY TO CARD No. 29.

By this weight, gold, silver, jewels, electuaries, and all liquors are weighed; but it is seldom used in the United States.

Merchants that receive considerable sums of gold, overseers of the mint, banking houses, and silversmiths, make use of this weight.

NOTE.—A carat is the twenty-fourth part of any quantity or weight.

Twenty-two carats of gold, and 2 carats of copper melted together, make the standard for gold.

Eleven oz. 2 pwts. of fine silver, melted with 18 pwts. of copper, make the true standard for silver coin.

In these cases copper is called *alloy*.

LESSON 1.

In 30 lb. 11 oz. how many pennyweights?

12 ounces in a pound. Ans. 7420 pwts.

371
20 pennyweights in an ounce.

7420

LESSON 2.

In 8 lb. 3 oz. 15 pwts. of silver, how many spoons of 4 oz 15 pwts. each? Ans. 21 spoons.

DIRECTIONS.

Reduce the whole quantity, 8 lb. 3 oz. 15 pwt. into pennyweights for a dividend.

Reduce the weight of each spoon into pennyweights for a divisor; the quotient will be the answer.

OPERATION.

lb. oz. pwt.
8 3 15
12

99 oz.
20

1995 pwts. dividend.

oz. pwt.
4 15
20

Divisor, 95 pwt.

95)1995(21
190

..95
95

KEY TO CARD No. 29.

LESSON 3. *Troy Weight.*

A gentleman having 10 lb. 3 oz. of silver, wished to make candlesticks of 1 lb. cups of 6 oz. table spoons of 2 oz. and tea spoons of ½ an ounce, and to have an equal number of each; what was that number? Ans. 6 of each.

Directions.

1. Reduce the given quantity of silver, viz. 10 lb. 3 oz. to pennyweights for a dividend.
2. Reduce each article to pennyweights and add them: Take the amount for a divisor.

lb. oz.	lb. pwt. in a
10 3	1×12×20=240 candlestick.
12 oz. in a pound.	6 oz. ×20=120 cup.
——	2 oz. ×20= 40 table spoon.
123 oz.	½ oz. = 10 tea spoon.
20 pwt. in an ounce.	——
——	410 Amount.
2460 pwt. the quantity of silver.	

2460÷410=6 for answer.

APOTHECARIES' WEIGHT.

The denominations are:

20 grains, marked gr. make	1 scruple,	℈
3 scruples,	1 dram,	ʒ
8 drams,	1 ounce,	℥
12 ounces,	1 pound,	℔.

Apothecaries mix their medicines by this weight; but buy and sell by Avoirdupois.

KEY TO CARD No. 29.

LESSON 1.

In 5 ℔. 8℥ 4ʒ 2℈ 17 gr. how many grains?

	℔.	℥	ʒ	℈	gr.
	5	8	4	2	17
Ounces in a pound,	12				
Ounces,	68				
Drams in an ounce	8				
Drams,	548				
Scruples in a dram,	3				
Scruples,	1646				
Grains in a scruple,	20				
Result in grains,	32937 Answer.				

LESSON 2.

In 32937 grains how many pounds?

Answer, 5 ℔. 8℥ 4ʒ 2℈ 17 gr.

Grains.	
2|0)3293|7	
3)1646	17 grains over.
8) 548	2 scruples over.
12) 68	4 drams over.
5 ℔.	8 ounces over.

LESSON 3.

If an Apothecary mix

℔.	℥	ʒ	℈	
	3	5	1	Aloes,
	4	7	2	Rhubarb,
	2	6	1	Castile soap,
	2	1	2	Calomel;
1	1	5	0	

How many pills may he form of 4 grains each?
Answer, 1635.

12

13 ℥
8

109 ʒ
3

327 ℈
20

6540 gr. ÷ 4 = 1635 Pills.

CARDS ARE OMITTED AT PRESENT.

CLOTH MEASURE.

4 nails, marked na. make	1 quarter of a yard,	qr.
4 quarters,	1 yard,	yd.
3 quarters,	1 Ell Flemish,	E. Fl.
5 quarters,	1 Ell English,	E. E.
6 quarters,	1 Ell French,	E. Fr.

LESSON 1.

In 75 yards how many quarters and nails?

Answer, 300 quarters, 1200 na.

75 yds.
4 quarters in a yd.
———
300 qrs. × 4 = 1200 na.

LESSON 2.

In 1200 nails how many yards? Answ. 75 yds.

1200 ÷ 4 = 300 qrs.
300 ÷ 4 = 75 yds.

4)1200
4) 300
75

LESSON 3.

In 441 yards, 1 qr. 1 na. how many nails? Ans. 7061 na.

yds. qr. na.
441 1 1
4
———
1765 qrs.
4
———
7061 nails.

LESSON 4.

In 36 Ells English how many quarters and nails?

Answer, 720 nails.

36 × 5 = 180. 180 × 4 = 720.

LESSON 5.

In 55 Ells French how many nails? Answer, 1320.

55 × 6 × 4 = 1320.

LESSON 6. *Cloth Measure.*

How many yards of muslin in the four following pieces?

	yds.	qrs.	na.
1 piece,	18	2	3
2	19	1	2
3	21	2	1
4	20	1	2
Answer,	80	0	0

DRY MEASURE.

2 pints, marked pt. make	1 quart,	qt.
8 quarts,	1 peck,	pk.
4 pecks,	1 bushel,	bu.

LESSON 1.

In 5 loads of wheat, each 21 bushels, how many pecks?

$21 \times 5 \times 4 = 420$. Answer, 420 pecks.

LESSON 2.

A farmer wishes to seed 54 acres with wheat, at the rate of 5 pecks to the acre; how much wheat is required?

54 acres, Answer, 67 bu. 2 pks.
5 pecks to the acre.

$54 \times 5 \div 4 = 67\frac{1}{2}$.

4)270 pecks.
67 bu. 2 pks.

LESSON 3.

A merchant wishes to transport 504 bushels of flaxseed, in casks that will hold 7 bushels each; how many casks are wanted? $504 \div 7 = 72$. Answer, 72 casks.

WINE MEASURE.

4 gills, marked gi. make	1 pint,	pt.
2 pints,	1 quart,	qt.
4 quarts,	1 gallon,	gal.
31½ gallons,	1 barrel,	bl.
42 gallons,	1 tierce,	tier.
63 gallons,	1 hogshead,	hhd.*
2 hogsheads,	1 pipe,	p.
2 pipes,	1 tun,	T.

NOTE.—231 solid inches make a gallon.

* A hogshead in the United States is of no certain quantity; it contains from 100 to 125 gallons; but generally about 112.

LESSON 1. *Wine Measure.*

In 112 gallons how many pints? Answer, 896.

```
  8 pints in a gallon.
 ---                       112×8=896.
896 pints.
```

LESSON 2. *Wine Measure.*

A vintner had 2 pipes of wine, each containing 126 gallons, and he wished to draw it off into bottles of 7 gills each; how many bottles were sufficient? Ans. 1152.

```
                           126 gallons in a pipe.
                             2 pipes.
                           ---
                           252 gallons in all.
                             4 quarts in a gallon.
                          ----
                          1008 quarts in the whole.
                             8 gills in a quart.
                          ----
÷Gills in each bottle,  7)8064 gills in the whole.
                          1152 number of bottles.
```

LESSON 3. *Wine Measure.*

If a grocer reduce 126 gallons of brandy, by mixing water equal to one fourth the quantity of brandy, how many gallons will he have in the whole? Answer, 157 gal. 2 qts.

126÷4=31 gal. 2 qts. over.

31 gal. 2 qts. + 126 gal. = 157 gal. 2 qts.

LONG MEASURE.

3	Barley corns, or bar, make 1 inch.	in.
4	Inches, 1 hand in measuring horses.	
9	Inches, 1 quarter of a yard.	
12	Inches, 1 foot.	ft.
3	Feet, 1 yard.	yd.
6	Feet, 1 fathom.	fm.
5½	Yards or 16½ feet, 1 rod, pole, or perch.	
40	Poles, 1 furlong.	fur.
8	Furlongs, 1 mile.	mile.
3	Miles, 1 league,	lea.

But, in measuring distances, the *Chain* is preferable to the *Rod* or *Pole*.

7.92 Inches, - make	1 link.	L.
25 Links,	1 pole or perch.	P.
4 Poles, or 100 links,	1 chain.	ch.
10 Chains,	1 furlong.	fur.
80 Chains or 8 furlongs,	1 mile.	

LESSON 1.

In 3½ miles how many poles?

3½ miles = 3.5 × 8 = 28 fur. × 40 = 1120 P.

OPERATION.

3.5 Miles.
8 Furlongs in a mile.

28.0 Furlongs.
4 0 Poles in a furlong.

1120 Poles.

Ans. 1120 Po.

LESSON 2.

In 1122 Poles, how many feet?

16.5 feet = 1 pole × 1122= 18513.0 feet.

OPERATION.

1122 poles.
16.5 feet in a pole.

5610
6732
1122

18513.0 feet.

Ans. 18513.0 ft.

LESSON 3.

In 18513.0 feet, how many poles? Ans. 1122 poles.

18513.0÷16.5=1122

OPERATION.

16.5)18513.0(1122
165

201
165

363
330

330
330

LESSON 4.

In 1 mile how many yards?

1 mile=8 fur.× 40=320 poles.
5.5 yards=1 pole.
320×5.5=1760.

OPERATION.

1 Mile=8 fur.
40 poles in a fur.

320 poles in a mile.
5.5 yards in a pole.

160
160

Ans. 1760.0 yards in a mile.

LESSON 5.

A bridge builder engaging to erect a bridge over a stream 17½ rods wide, wanted 6 stringpieces, each 17½ rods long; how many feet in length were required?

17½ rods=17.5×6=105 rods. 105 rods×16.5 the number of feet in a rod=1732.5 feet.

OPERATION.

17.5 rods, length of bridge
6 stringpieces.

105.0 rods in the whole.
16.5 feet in a rod.

525
630
105

1732.50 Ans. 1732 feet .50 or .5 or ½.

LESSON 6.

How many links in 45 poles?

45 × 25 the number of links in a pole = 1125

45 Poles.
25 Links in a pole.

225
90

1125 Links, the Ans.

LESSON 7.

In 1 Mile how many links?

1 mile = 80 chains. 80 chains × 100 the number of links in a chain = 8000 Links.

By adding or annexing two ciphers, multiplies by 100.

× 80 chains in a mile,
by 100 links in a chain.

Prod. 8000 links in a mile.

LESSON 8.

How many inches and feet in 75 links?

75 links × 7.92 the number of inches in a link = 594 in. 594 inches ÷ 12 = 49 feet 6 in.

OPERATION.

7.92 inches in a link.
75 links.

3960
5544

594.00 inches.

12)594.00
49.50

.50=½ a foot or 6 in.

Ans. 594 in.=49 feet 6 in.

LESSON 9.

From Albany to New-York is a distance of 165 miles; how many rods and links?

165×8 the furlongs in a mile= 1320 fur. 1320×40 the rods in a furlong=52800 R. 52800 ×25 the links in a rod = 1320000 Links.

OPERATION.

165 Miles.
8 Furlongs in a mile.

1320 Furlongs.
40 Rods in a furlong.

52800 Rods.
25 Links in a rod.

2640
1056

1320000 Links in 165 miles.

Answer, 1320000 Links.

LESSON 10.

In 125 rods how many chains and links?

Answer, 31 ch. 25 Links.

OF LAND AND SQUARE MEASURE.

RULE 1.

To bring rods into chains, *divide* by 4.

4)125

31 and 1 over. 1 rod=25 links.

RULE 2.

Multiply by 25 *and divide by* 100.

LESSON 11.

In 19 rods how many chains and links?

Answer, 4 ch. 75 links, or, 4.75 chains, that is, 4 ch. and 75 hundredths of a chain; because 100 links make 1 chain, the same as 100 cents make 1 dollar.

OPERATION.

19 Rods.
25 Links in a rod.
——
95
38
——
4.75 475÷100=4.75

We will attend more particularly to chains and links in Land Measure.

LESSON 12.

A carpenter has 68 feet of joist, which he wishes to cut into braces of 4 feet and 3 inches long; how many braces may he have? Answer, 16 braces.

68×12=816 inches for a dividend:
4 ft.×12=48+3 in.=51 inches for a divisor.

```
  68                 ft. in.
  12                  4   3 in. in a brace.
 ———                 12     in. in a foot.
51)816(16             —
  51                 51 divisor.
  ——
  306
  306
```

LAND AND SQUARE MEASURE,

CALLED MENSURATION OF SUPERFICIES.

144 square inches make	1 square foot.
9 square feet	1 square yard.
30¼ square yards, or 272¼ square feet	1 square rod.
40 square rods	1 square rood.
4 square roods	1 acre.
640 acres in	1 square mile.

Let the first business be to investigate and prove our Table.

OF LAND AND SQUARE MEASURE.

LESSON 1.

Suppose we have 72 boards, each 12 inches wide, and 14 feet long; how many feet in the whole? Answer, 1008 ft.

72 boards.
14 feet in each board.
288
72
1008

Thus we have 1008 feet in the whole; but reduce these square feet into inches, and divide them by 144 the number of inches in a foot; see if the result will be 1008.

1008 × 12 × 12 = 145152 ÷ 144 = 1008 for proof.

1008 ft. } 12 in. long and 12 in. wide.
12
12096
12
144)145152(1008
144
..1152
1152

LESSON 2.

How many square feet in 72 boards, each 14 feet long and 16 inches wide?

Answer, 1344 feet.

72 boards.
14 feet long.
288
72
1008 feet 12 in. by 16.

Lesson 2. *Continued.*

1008 feet, 12 in. by 16.
12
12096
16
72576
12096
144)193536(1344 feet.
144
.495
432
.633
576
.576
576

LESSON 3.

If the roof of a house be 14 feet from the ridge to the edge of the eaves, and from gable end to gable end 21 feet; how many superficial feet including both sides?

Answer, 588 feet.

14 × 21 = 294 for one side, 294 × 2 = 588.

LESSON 4.

If a barn-floor be 35 feet long and 21 feet wide, how many planks 14 feet long by 15 inches wide, will lay the floor? Answer, 42 planks.

OF LAND AND SQUARE MEASURE.

35 × 21 = 735 feet: 735 × 12 × 12 = 105840 inches for a dividend.

14 × 12 × 15 = 2520 inches for a divisor.

35 feet the length of the [floor.
21 the width.
35
70
735 feet 12 by 12 in.
12
8820
12
105840 inches for a dividend.

14 feet in each plank 12 by [15 inches.
12
168
15
840
168
2520 inches in each plank for [a divisor.
2520)105840(42 planks.
10080
..5040
5040
....

LESSON 5.

In 42 planks, each 14 feet in length and 15 inches wide, how many feet? Answer, 735 feet.

Observe the planks are 14 feet long, and every foot is 15 inches wide. 15 inches make 1 foot 3 inches, or 1¼ foot. Multiply 1 ft. 3 in. by 14, the product will be the contents of one plank. Multiply by 7 and by 2. Carry at 12 in the inches.

1 ft. 3 in.
7
8 9
2
17 6 contents in each plank.

Multiply 17 ft. 6 in. by 42, the product will be the whole number of feet in 42 planks. Multiply by 7 and by 6.

ft.	in.
17	6
	7
122	6
	6
735	0

A SHORT OPERATION.

42 planks×by 14 and ¼ of the product added.
14
4)588
147
735 feet.

OF LAND AND SQUARE MEASURE.

Lesson 5, performed decimally.

Each foot of the plank contains 1 foot 3 inches, or 1¼ foot, or, 1.25 foot.

1.25×14=17.50; that is, 17½ feet in each plank.
17.50×42=735.

1.25 foot in each foot of a plank.	17.50
14 ft. long.	42
500	350
125	700
17.50	735.00

We will not attend to many of these short rules, till our minds are better informed; whereby we can scan the origin and nature of the work to be performed.

LESSON 6.

A paver undertook to lay a pavement 10 rods by 27 feet; how many square yards must be allowed him in settlement? Ans. 495 yards.

5½ yards or 5.5 yards=1 rod.

10 rods×5.5=55 yards, the length of the pavement.

27 feet=9 yards, the breadth.

Multiply the length by the breadth, the product will be the superficial contents.

55 yards the length.
9 yards the breadth.

495 square yards.

Note.—In all superficies multiply the length by the breadth: the product will give the superficial contents or area.

The multipliers must be of one denomination: if the length be in rods, and the breadth be in feet; reduce the length to feet.

LESSON 7.

A spadiard digs a garden 8 rods in length, and 66 feet in breadth; what is the area or superficial contents in square yards? Ans. 968 square yards.

OF LAND AND SQUARE MEASURE.

16.5 feet make 1 rod.
8 rods the length.

132.0 feet in length.
66. feet in breadth.

792
792

8712 square feet to be reduced into square yards.

Look at the table: 9 feet 1 yard.

÷ by 9)8712 feet.
968 square yards.

LESSON 8.

A ploughman ploughed a piece of land, 40 poles long and 18 poles wide; what was the area in acres?

Answer, 4.5 or 4½ acres. ½=2 roods.

REMARKS.

The ancient rule was to divide the number of square rods by 160; because 160 square rods or poles make an acre; but the easier method is wrought by chains and links. For, as chains and links are formed on the principle of dollars and cents, all our operations with them are very easy and expeditious.

You will see by the table of Long Measure, 25 links make 1 pole. Four poles or 100 links, 1 chain.

To bring poles into chains.

RULE.

Divide by 4; or, multiply the poles by 25, and divide the product by 100.

Let us attend to Lesson 8. *See Card* 30.

25×40=1000 square links. 25×18=450 links.

450 links the breadth, × by 1000 links the length, produce 450000 links, the area required.

How shall we reduce these square links into acres?

OF LAND AND SQUARE MEASURE.

RULE.

Divide links by *one hundred thousand* to make acres, because 100000 square links make 1 acre.

Example A. *Card* 30.

The above area contains 450000 square links. Divide 450000 by 100000: The quotient will be 4 acres and 2 roods.

100000)450000(4 acres.
400000

50000 links.
4 roods in an acre.

100000)200000(2 roods or ½ an acre.
200000

But here is no need of all this formality with Long Division. Begin at the right of links and count off five figures towards the left; there place a separatrix: The figures on the left will be acres, and those on the right decimal parts of an acre; as, .5 .25 .4 .75 &c.

These decimal parts may be reduced to roods, that is, quarters of acres, by multiplying by 4, or to perches, by multiplying the second product by 40.

EXAMPLES.

1. B. Take the aforegoing 450000 links. Cut off five decimals on the right 4.50000 then multiply the decimal .50000 by 4: the result will be 4 acres, 2 roods.

2. C. In 4816235 square links, how many acres?

Answer, 48 acres and 25 perches.

OPERATION.
Acres, 48.16235
4

Parts of a rood, .64940
40

Perches, 25.97600

The remaining decimals are 9 tenths, 7 hundredths, and 6 thousandths of a perch, or, 976 thousandths of a perch.

The perches might, according to custom, be called 26, because the decimals near the point, are very large; as, .97 of any thing, is nearly equal to a whole.

OF LAND AND SQUARE MEASURE.

3 D. In 7583100 square links, how many acres?

A. 75.83100
4 roods in an acre.

R. 3.32400
40

P. 12.96000

Answer, 75 acres, 3 roods, 12 perches, and 96 hundredths of a perch.

But an easier method still, is to let the decimals of an acre remain in their natural state thus, 75.83100, that is, 75 acres and 8 tenths 3 hundredths and 1 thousandth of an acre; or, 831 thousandths of an acre. See E. on the card.

Chains and Links.

Under Lesson 11, in Long Measure, we had a promise of attending more particularly to chains and links.

Reduce the following sums of links to chains, by the shortest method.

RULE.

Point off the two right hand figures; those on the left are chains: the right are links.

Sums in Links.				*Answers in Chains and Links.*
750	-	-	-	7.50
465	-	-	-	4.65
4475	-	-	-	44.75
4052	-	-	-	40.52
11114	-	-	-	111.14
110121	-	-	-	1101.21

See F. *Card* 30.

LESSON 9.

A farmer has a piece of wood land, 120 poles in length, and 59 poles in breadth; how many acres does it contain?

Answer, 44 acres 25 hundredths of an acre.

25×59=1475 links. 25×120=3000 links.

Point off two figures on the right, the left will be chains.

Ch. L.
1475 links=14.75 breadth.
3000 links=30.00 length.

Chains and links multiplied together, produce links.

OF LAND AND SQUARE MEASURE.

Multiply the breadth by the length, the product will be 4425000 square links.

Point off five places to the right, the left will be acres: the right will be decimals of an acre, viz: .25 hundredths.

OPERATION.

59 poles.
25 links in a pole.
295
118
1475 links breadth.

25 links in a pole.
120 poles.
3000 links in length.

Ch. L.
14.75 breadth.
30.00 length.
44.25000 for Answer.

DIGRESSION.

Reduce .25 of an acre to its proper quantity or integral value by Lesson 7, in Decimals.

.25
4 roods in an acre.
Answer, 1.00 rood.

LESSON 10.

A grazier has a piece of grazing land 103 poles lengthwise north and south, and 80 poles east and west; he designs 11 acres on the south part for sheep, 8 acres for cows adjoining north of the sheep, and the residue of the tract for fattening oxen: how far north from the south end, shall the lines of partition be drawn; and what number of acres will remain for oxen?

Answer, the line between the sheep and cows must be 5 ch. 50 L. north from the south end of the tract, the line between the cows and oxen must be 4 ch. north from the allotment for sheep, and the reservation for oxen will contain 32.5 acres.

Directions.

1. Reduce the 11 acres into links, by annexing five ciphers, for a dividend.

2. Reduce the south line into links for a divisor; the quotient will be the breadth of the first allotment north and south.

11 acres for sheep = 1100000 links, dividend 80 poles × 25 = 2000 links for a divisor.

```
2000)1100000(550 links for the breadth of first allotment.
     10000
     -----
      10000
      10000
     ------
     .....0
```

3. Reduce 8 acres into links for the second allotment for a dividend, and divide by the former divisor; the quotient will be the breadth of the allotment for cows.

```
8 acres = 800000 links.
   2000)800000(400 links for second allotment.
        8000
        ----
        ....00
```

4. Subtract the sum of the two allotments from the contents of the whole tract, the remainder will be the number of acres for oxen.

Contents of the whole.

103 poles × 25 = 2575 links north and south. 80 poles × 25 = 2000 links east and west.

```
2575 links.
  2000
--------
51.50000
```

This makes 51.5 acres for the whole tract.

11 acres for sheep + 8 acres for cows = 19 acres.

51.5 — 19 = 32.5 for oxen.

	Links		Ch.L.	Links.		Ch.L.
NB.	550	=	5. 50	400	=	4. 00

See the Rule under *Chains and Links.*

SOLID MEASURE.

By this measure the solid or cubic contents of all things are ascertained which have length, breadth, and thickness.

For instance, a piece of square timber has length, breadth, and thickness. A cord of wood has lenght, breadth, and height. A bin of grain has length, breadth, and depth.

DENOMINATIONS.

1728. solid inches, make	1 solid foot.*
231. solid inches,	1 wine gallon.
268.8 solid inches,	1 gal. dry measure.
282. solid inches,	1 beer gallon.
2150.4 solid inches,	1 bushel.
27. solid feet,	1 yard.
40. feet of round timber or 50. feet of hewn timber,	1 ton or load.
128. feet solid measure,	1 cord.

The usual form of a cord, is 8 feet long, 4 feet high, and 4 feet wide.

LESSON 1.

If a stick of timber be 18 inches in breadth, 15 inches thick, and 28 feet in length, how many solid feet? And how much will it amount to at 8 cents a foot? Answer, 52½ feet, and it cost 4 dol. 20 cents.

1. Find the superficial content of one end, by multiplying the breadth by the thickness.

2. Multiply this superficial content, by the inches in the length.

3. Divide the last product by 1728, the quotient will be solid feet.

4. If inches remain, multiply them by 12 and divide again by 1728, the quotient will be inches or parts of a solid foot.

---

* 12 × 12 × 12 makes the inches of a solid foot.

OPERATION.

The end of the stick is 18 by 15.

18 inches broad.
15 inches thick.

90
18

270 inches is the superficial [content.
28 feet long.
12

336 inches long.
270 surface.

23520
672

90720 solid inches.

90720 solid inches to be divided by the number of solid inches in a solid foot, viz. 1728.

1728)90720(52 feet.
8640

4320
3456

864
12

1728)10368(6 inches.
10368

.....

N. B. The 6 inches in the quotient, must not be considered as merely of 6 square inches, or 6 superficial inches, because they consist of half a cubic foot, or $\frac{6}{12}$ of a solid foot, or .5 of a solid foot, &c. And if 3 had happened in place of 6, then the number would be $\frac{3}{12}$, or $\frac{1}{4}$, or .25 of a solid foot. If the quotient had been 4, it would be $\frac{4}{12}$ or $\frac{1}{3}$ or ,33333 + of a solid foot.

Rules for a second operation.

1. Multiply the breadth 18, by the length, to find the *superficial* content of one side.
2. Multiply that *superficial* content by the thickness 15, and divide the product by 1728. The quotient will be the *solid* content.

28 feet the length.
12 inches in a foot.

336 inches in length.
18 inches in breadth.

2688
336

6048

6048 inches of one side must be 15 times that sum.

30240
6048

90720 in. to be divided by [1728

Continued.

```
1728)90720(52 feet.   ||        864
     8640             ||         12
     ----             ||       ----
     . 4320           ||  1728)10368(6 in.
       3456           ||       10368
       ----           ||       -----
     . 864            ||       .....
```

Rules for a third operation decimally.

1. Reduce 1 ft. 3 in. the thickness, and 1 ft. 6 in. the breadth, into decimals of a foot, by Case 3, in decimals; then we shall have 1.25 foot for the thickness, and 1.5 foot for the breadth at the end of the stick.

2. Multiply the thickness by the breadth, the product will be the superficial content of the end, in a foot and decimals of a foot.

3. Multiply this superficial content by the length in feet, the product will be the answer.

```
1 ft. 3 in. = 1.25
1 ft. 6 in. = 1.5
              ----
               625
              125
              -----
              1.875 the superficial content of one end.
                 28 feet the length.
         ----------
              15000
              3750
         ----------
Feet,        52.500 Answer.  And as to the price,
```

52.5 x 8 = 420.0 = 4 dolls. 20 cents.

See a short method; Lesson 11th in Duodecimals.

LESSON 2.

In a cellar 28 feet long, 14 feet wide, and 8½ feet deep, how many solid feet? Answer, 3332 feet..

LESSON 3.

In a pile of wood 12 feet long, 4 feet wide, and 7 feet high, how many cords? And how much will it amount to in dollars and cents at 4 dol. 25 cents a cord?

Ans. 2 cords and .625 of a cord at 425 cents = 11 dol. 15.625 cents.

```
  12 feet long.
   4 feet wide.
  ----
  48 superficial feet.
   7 feet high.
  ----
128)336(2 cords.
    256
    ----
128)80.000(.625 decimals.
     76 8
     ----
      . 320
        256
        ---
        .640
         640
```

```
 Cords,  2.625
 At,      425 Cents.
        -------
         13125
         5250
        10500
        -------
Cents,  1115.625
```

LESSON 4.

A farmer bought a cider mill wheel by the solid foot; the diameter, that is, the breadth across the middle, was 5 ft. 9 in. and the thickness 13 inches; how many solid feet in the wheel? Answer, 28.

RULE.

1. Multiply the square of the diameter by .7854 the product will be the superficial content of the wheel.

2. Multiply the superficial content by the thickness, the product will be the answer.

5 ft. 9 in.=5.75 feet to be multiplied by itself.

```
     5.75
   -------
     2875
    4025
   2875
   -------
   33.0625 the square of the diameter.
                33.0625
Common multiplier, .7854
              ----------
                1322500
               1653125
              2645000
             2314375
             ----------
             25.96728750 superficial content.
```

Continued.

25.96728750 superficial content.
13 inches = 1.08+ foot.* 1.08 thickness.

20773830000
25967287500

28.0446705000

N. B. Multiply the square of the diameter of any circle by .7854, the product will be the superficial content.

LESSON 5.

How many solid feet in a well that is 8 feet across and 30 feet deep? Ans. 1507 ft. 11 in.

8 feet the diameter multiplied by itself.
8

64 the square of the diameter.

.7854 × by 64
64

31416
47124

50.2656 surface of the top.
30 the depth.

Solid feet, 1507.9680
12

Inches, 11.6160

LESSON 6.

In a stick of round timber 40 feet long, and 15 inches thick, how many solid feet? Answer, 49.

15 inches = 1 ft. 3 in. = 1.25 diameter.
1.25

625
1500

1.5625 the square of one end.†

Lesson 6, *continued.*

---

* The sign of addition + annexed to a decimal, denotes that it is a *surd*.

† For distinction, call the square end of a stick, the *base*.

1.5625 the square of one end.
Common multiplier of a circle, .7854
62500
78125
125000
109375
1.22718750 content of base.
40 the length.
Solid feet, 49.08750000

LESSON 7.

In a bin of wheat 6 feet long, 4½ feet wide, and 3 feet deep, how many bushels?

4.5 feet wide.
6 feet long.
27.0 superficial feet.
3 feet deep.
81 solid feet.
1728 solid inches in a foot.
81 feet.
1728
13824
Inch. in a bu. 2150.4)139968.0000(65.089 bushels.
129024 4
.109440 .356 pecks.
107520 8
..192000 2.848 quarts.
172032 8
.199680 6.784 gills.
193536 4
..6144 3.136 fourths of gills.

Thus we have for an Answer, 65 bush. 2 qts. 6 gills, 3 quarters of a gill, [or more naturally, *jill.*]

DUODECIMALS.

That is, decimals of 10 and 2; or of 12.

This Rule is very convenient for workmen and artificers in casting up the contents of their work: we shall operate with it in the same manner as with Compound Multiplication, without reducing the several denominations into one number, and shall invariably carry at every twelve till coming to feet.

The denominations are as follow.

12 fourths, '''' make	1 third.
12 thirds, '''	1 second.
12 seconds, ''	1 inch.
12 inches, in.	1 foot.

Inches are called *primes;* but the plainer our expressions, the better: call them *inches.*

When multiplying by Duodecimals, it is customary to begin with the highest number at the left hand, and produce one product with feet; setting inches under inches, and feet under feet.

Then begin with inches and set the first figure in the product one place further towards the right, under seconds, &c.

Note.—Inches multiplied by feet, produce inches and feet. Inches multiplied by inches, produce seconds and inches. Inches multiplied by seconds, produce thirds and seconds, &c. Therefore we must be cautious and mentally divide every product by twelve, and set the remainder one place further towards the right.

EXAMPLES.

LESSON 1.

A joiner has a piece of board 8 feet, 6 inches long, and 1 foot 6 inches wide; how many superficial square feet?

Answer, 12 ft. 9 in. that is, 12 square feet and $\frac{3}{4}$ of another foot.

OPERATION.

Ft.	in.	″	
8	6	0	long,
1	6	0	wide
8	6	0	
4	3	0	
12	9	0	Answer.

PROOF.

In the next place we will prove this by superficial square measure.

8 ft. 6 in. = 102 inches.
1 ft. 6 in. = 18 inches.

102 in. in length.
18 in. wide.
816
102
square in.
in a ft. 144)1836(12 feet.
144
396
288
108 in. remain.
12 seconds in [an inch.
square sec.
in an in. 144)1296(9 square in.
1296 [or $\frac{3}{4}$ of a ft. [for proof.

PROOF BY DECIMALS.

8 ft. 6 in. = 8.5 in length.
1 ft. 6 in. = 1.5 in breadth.
425
85
Feet, 12.75

.75 of a foot = $\frac{3}{4}$ of a foot or 9 inches. See decimals, Case 2nd.

EXAMPLE.

.75 of a foot.
12 inches in a foot.
Inches 9.00

LESSON 2.

"In a board 17 feet 7 inches long, and 1 foot 5 inches wide, how many square feet?"
Ans. 24 ft. 10 in. 11 sec.

Ft.	in.	″	
17	7	0	long.
1	5	0	wide.
17	7	0	
7	3	11	
24	10	11	Ans.

Begin with the 1 foot on the left and say, one time 7 inches is 7; set 7 in the inches; one time 17 is 17; set 17 in the feet: then begin with the inches and say, 5 times 7 are 35; not 35 inches, but 35 seconds: 12 in 35? twice and 11 over; set 11 in the seconds and carry 2 to the inches; then say, 5 times 17 are 85, and 2 I carried are 87: 12 in 87? 7 times and 3 over; set 3 in the inches and 7 in the feet. Add the two products and the work is done.

LESSON 3.

"How many solid feet in a stick of timber 12 feet 10 inches long, 1 foot 7 inches wide, and 1 foot 9 inches thick?"
Ans. 35 ft. 6 in. 8″ 6‴

OPERATION.

	Ft.	in.	″	‴	
	12	10	0	0	long.
×	1	7	0	0	wide.
Product by 7,	7	5	10	0	
Product by 1,	12	10	0	0	
	20	3	10	0	superficial content.
×	1	9	0	0	thickness.
Product by 1,	20	3	10	0	
Product by 9,	15	2	10	6	
Answer,	35	6	8	6	solid content.

In multiplying the feet, the whole amount of the product must be ascertained, and whatever number of inches are carried, must be added; then divide by 12, set the remainder in the place of inches, and carry the quotient to the feet. Example: in the last line of multiplication we say, 9 times 20 make 180, and 2 to carry make 182. 12 in 182? 15 times and 2 over; set 2 for inches and carry 15 to the feet.

LESSON 4.

"How many solid or cubic feet of wood in a load 6 feet 7 inches long, 3 feet 5 inches high, and 3 feet 8 inches wide?" Ans. 82 ft. 5 in. 8″ 4‴

OPERATION.

	Ft.	in.	″	‴
Length,	6	7	0	0
Height,	3	5	0	0
	19	9	0	0
	2	8	11	0
Superficial content of one side,	22	5	11	0
Breadth,	3	8	0	0
+ {	67	5	9	0
	14	11	11	4
Answer,	82	5	8	4

An easy method for calculating with Duodecimals.

1. Set the multiplicand in usual form: then place the feet of the multiplier under the lowest denomination of the multiplicand, and set the remaining parts of the multiplier off to the right in their natural order.

2. Multiply first with the right hand figure of all, place the first product figure under its multiplier, and proceed in order as in Compound Multiplication.

3. Go through with each denomination in the same manner, placing the first figure under its multiplier towards the left.

NOTE.—If there be no feet in the multiplier, supply their place with a cipher.

EXAMPLE.

LESSON 5.

If the surface of a stone be 8 ft. 6 in. 9 seconds in length, and 7 feet 3 inches 8 seconds in breadth, what is the superficial content? Answer, 62 ft. 6 in. 7″ 9‴

OPERATION.

Ft.	in.	″	‴	⁗	
8	6	9			
		7	3	8	
	5	8	6	0	
2	1	8	3		
59	11	3			
62	6	7	9	0	Answer.

LESSON 6.

What is the superficial content of a table 8 feet 9 inches 10 seconds, by 5 feet 6 inches 7 seconds?

Answer, 48 ft. 11 in. 2″ 8‴ 10⁗

OPERATION.

	Ft.	in.	″	‴	⁗
	8	9	10		
			5	6	7
		5	1	8	10
	4	4	11	0	
	44	1	2		
Ans.	48	11	2	8	10

LESSON 7.

A cabinet-maker had three pieces of plain furniture finished off by the foot; one piece 4 feet 3 inches long, and 3 feet 7 inches wide; a second piece 5 feet 8 inches long, and 4 feet 5 inches 7 seconds wide; and a third piece 6 feet 9 inches 3 seconds long, and 4 feet 6 inches wide: how many superficial square feet did the whole contain?

Answer, 71 ft. 0 in. 0″ 2‴

	Ft.	in.	″	‴	
First piece,	4	3			long.
		3	7		wide.
	2	5	9		
	12	9			
Contents,	15	2	9		

	Ft.	in.	″	‴	
Second piece,	4	5	7		wide.
			5	8	long.
	2	11	8	8	
	22	3	11		
Contents,	25	3	7	8	

	Ft.	in.	″	‴	
Third piece,	6	9	3		long.
			4	6	wide.
	3	4	7	6	
	27	1	0		
Contents,	30	5	7	6	

	Ft.	in.	″	‴
Contents of the 1st piece,	15	2	9	
2nd,	25	3	7	8
3rd,	30	5	7	6
Total,	71	0	0	2

LESSON 8.

A plasterer overlaid the walls of a room 21 feet 3 inches long, 14 feet 4 inches wide, and 7 feet 5 inches high; how many square feet were contained in the four superficies, after deducting 14 feet for the fire place?

Answer, 513 f. 9 in. 10″

	Ft.	in.	″	
One side,	21	3		long.
Height, 7 feet, 5 inches,		7	5	
	8	10	3	
	148	9		
Contents of one side,	157	7	3	
The opposite side,	157	7	3	
Total of the sides,	315	2	6	
One end,	14	4		long.
Height 7 feet, 5 inches,		7	5	
	5	11	8	
	100	4		
Contents of one end,	106	3	8	
The opposite end,	106	3	8	
Total of the ends,	212	7	4	
do. of the sides,	315	2	6	
Total in square feet and inches,	527	9	10	
Deduct for the fire place,	14	0	0	
Neat amount of the superficies,	513	9	10	

LESSON 9.

How many solid feet in a stick of timber 48 feet 6 inches long, 1 foot 3 inches thick, and 1 foot 9 inches wide?

Answer, 106 f. 1 in. 1″ 6‴

	Ft.	in.	″	‴
Length,	48	6		
Thickness, 1 foot 3 inches,		1	3	
Product of 3 inches,	12	1	6	
Product of 1 foot,	48	6		
Superficial content of one side,	60	7	6	

Continued.

	Ft.	in.	'	''
Superficial content of one side,	60	7	6	
Width, 1 foot 9 inches,			1	9
Product of 9 inches,	45	5	7	6
Product of 1 foot,	60	7	6	
Answer,	106	1	1	6

A SHORT METHOD BY PRACTICE.

	Ft.	in.	'	''
The length,	48	6	0	0
The ¼ of the length,	12	1	6	0
Superficial content of one side,	60	7	6	0
Half the superficial content,	30	3	9	0
Half of that half,	15	1	10	6
Answer,	106	1	1	6

PROOF OF DUODECIMALS.

The length of the stick in feet and in.		48	6
Inches in a foot × by		12	
Length in inches,		582	
One side, 1 foot 3 inches,	=	15	inches.
		2910	
		582	
Superficial content of one side,		8730	inches.
The other side, 1 foot 9 inches,	=	21	inches.
		873	
		1746	

Solid or Cubic Inches, 183330 to be divided by 1728, that is, the number of solid inches in a solid foot.

1728)183330(106 feet.
1728

.10530
10368

$\frac{162}{1728}$ of a foot remain. ..162

Continued.

$\frac{162}{1728}$ of a foot remain,	162
Twelve inches in a foot,	12
	1728)1944(1 inch.
	1728
$\frac{216}{1728}$ of an inch remain,	.216
Twelve seconds in an inch,	12
	1728)2592(1 second.
	1728
$\frac{864}{1728}$ of a second remain,	.864
Twelve thirds in a second,	12
	1728)10368(6 thirds.
	10368

REMARK.

By the last operation we can perceive the utility of *Duodecimals:* this requires one hundred and nineteen figures, while that immediately under Lesson 9, requires only thirty-three.

LESSON 10.

A carman undertook to move a bank of earth, 224 feet 7 inches in length, 48 feet 9 inches in breadth, and 7 feet 5 inches in height; how many solid feet in the bank?

Answer, 81200 ft. 10 in. $11''$ $3'''$

DIRECTIONS.

Multiply the length,	224 ft.	7 in.
By the breadth,	48	9

Multiply by 8 and by 6 for 48 as in Compound Multiplication.

Then take aliquot parts arising from 9 inches—Consider first, that the bank contains 48 feet in breadth, and a strip also 9 inches wide; consequently, the breadth must be 48 feet, and ¾ of a foot, because 9 inches make ¾ of a foot: Now the half of the 224 feet 7 inches, will make a strip ½ a foot wide, and the half of that half, will make a strip ¼ of a foot wide; then ½ added to ¼, will make ¾, or a strip 9 inches wide.

	ft.	in.	″
The length,	224	7	
		8	
	1796	8	
		6	
Product of 48,	10780	0	
Half the multiplicand,	112	3	6
Half of that half,	56	1	9
Superficial content,	10948	5	3

This superficial content must be multiplied by the height, viz. 7 ft. 5 in. First multiply by 7 feet; then take aliquot parts arising from 5 inches: say, 4 inches are ⅓ of the multiplicand, and 1 inch is the ¼ of that third: This operation will produce the solid content in cubic feet.

	ft.	in.	″	‴
Superficial content or multiplicand,	10948	5	3	
Multiply by 7 ft.			7	
Product of 7 feet,	76639	0	9	
Third of the multiplicand,	3649	5	9	
A fourth of that third,	912	4	5	3
Answer,	81200	10	11	3

LESSON 11.

How many solid feet in a stick of timber 28 feet long, 1 ft. 6 in. wide, and 1 ft. 3 in. thick?

Answer, 52 feet, 6 inches.

28 feet the length,	28 ft.	
The fourth of the length,	7	
Superficial content of one side,	35	
Half the superficial content,	17	6 in.
Solid content,	52	6

EXPLANATION.

1. As the stick is 28 feet long, and 1 foot 3 inches thick; so there must be 28 superficial feet, and the fourth of 28 on one side; because a strip 28 feet long, and 3 inches wide,

is equal to one fourth of a strip the same length, and 12 inches wide: Therefore 28÷4=7 and 7+28=35 the superficial content of one side.

2. The stick is 1 foot and a half wide; therefore it will contain 35 solid feet, and the half of 35; consequently, 35÷2=17 ft. 6 in. and 17 ft. 6 in.+35 ft.=52 ft. 6 in.

TIME.

60	seconds, marked s. make	1 minute,	m.
60	minutes,	1 hour,	h.
24	hours,	1 day,	d.
7	days,	1 week,	w.
4	weeks,	1 month,	mo.
13	months, 1 day, 6 hours,	1 Julian year,	yr.

Explanation of the origin of the Julian year.

The Romans called the first day of each month, *calends*. Julius Cæsar, a character similar to Bonaparte, regulated the calendar about fifty or sixty years before the birth of Christ. Julius found, that 365 days were about 6 hours short of the true year: he decreed that the 24th day of February, in every fourth year, should be reckoned twice. This reckoning taking place 6 days before the calends of March, and one day being reckoned twice, gave it the appellation, *bissextilis*, which is literally, *the sixth of the calends twice*. But the Gregorian calendar, instituted by Pope Gregory the XIII, in 1582, and adopted by the British government in 1752, which we now use, drops three days of the Julian calendar in 400 years, and makes the year equal to 365 days 5 hours 49 m. 12 sec.

PERIODICAL YEAR.

Astronomers say, that the true periodical year, is calculated from "the time of the Earth's period about the Sun, in departing from any fixed point in the heavens, and returning to the same again;" it consists of 365 days, 6 hours, 9 minutes and 14 seconds.

TROPICAL YEAR.

The tropical year contains 365 days, 5 hours 48 minutes and 57 seconds—An explanation of its origin belongs to astronomers.

LESSON 1.

How many days from 15th January to the 19th August inclusive? Answer, 216 days.

Look in your Almanack, say,

In January,	16 days.
February,	28
March,	31
April,	30
May,	31
June,	30
July,	31
August,	19
Answer,	216

LESSON 2.

In 216 days how many weeks?

Answer, 30 weeks 6 days.

7 d. in a w. ÷ by 7)216
30 w. 6 d.

LESSON 3.

How many years from 1776 July 4th, to the 4th July, 1816. Answer, 40 years.

1816
1776
..40

LESSON 4.

If a man was born on the 25th October, 1755, how old will he be on the first of November 1815? Ans. 60 y. 6 d.

1815
1755
..60

October having 31 days, there are 6 days after his birth-day in the year 1815.

LESSON 5.

Having a note on interest, I wish to ascertain the number of days from 27th December, to the 16th of June following, inclusive; it being leap-year. Ans. 173 days.

December,	5 days.
January,	31
February,	29
March,	31
April,	30
May,	31
June,	16
	173

LESSON 6.

A gentleman began boarding on the 15th of May at breakfast—he paid his bill on the 19th of August after supper; how many weeks did he board, and how much was his bill at 4 dollars 75 cents a week after giving him 1 day's board gratis? Ans. 13 5/7 w. 65 dollars 12¼ cents.

May 17 days less 1=16 days.
June, 30
July, 31
August, 19

7)96
13w. 5d.

5 days = $\frac{5}{7}$ of a week
What is the decimal of $\frac{5}{7}$ of a week.

7)5.00
Ans. .71+
13.71 weeks.
475 cents a week.

6855
9597
5484

6512.25 cents = 65 dols. 12 c. and .25 of a cent.

LESSON 7.

Suppose we begin to reckon the 10th of Nov. and wish to know what time in the next year 21 weeks will end; on what day and of what month will it be allowing 28 days in February? Answer 6th of April.

Mode of Operation.

How many days in 21 weeks? 147. How many months? 5 and more. In what month will 5 end? April. How many days in those calendar months? If more than 147 deduct and find to what day in April the true time will come,

LESSON 8.

In 52 weeks, how many days? Ans. 364 days.
52x7=364.

LESSON 9.

In 156700 seconds, how many hours?
Answer, 43 hours, 31 min. 40 sec.

6|0)15670|0
6|0)261|1 40 sec.
43 h. 31 min. 40 seconds.

LESSON 10.

In 43 hours 31 minutes and 40 seconds, how many seconds? Answer, 156700 seconds.

h. m. s.
43 31 40
60 minutes in an hour, 60

2611
60 seconds in a minute, 60

156700 seconds.

LESSON 11.

How many days from the birth of Christ, to Christmas, 1815, allowing each year to contain 365 days and 6 hours?

Answer, 662928 d. 18 h. over.

As each year contains 6 hours more than 365 days, so we must have 1815 times 6 hours, and these hours must be divided by 24 to bring them into days.

1815 yrs.
365 d. in a yr.
9075
10890
5445
662475 d.
453 d. 18 h.
662928 d. 18 h.

1815 yrs.
6 hours
24)10890(453 days.
96
129
120
..90
72
Remain, 18 hours.

Proof by Compound Multiplication.

Carry at 24 in the hours.

One year, = 365 d. 6 h.
10
Ten years, = 3652 12
10
One hundred years, = 36525 0
10
One thousand years, = 365250 0
One hundred years, = 36525
8
Eight hundred years, = 292200
365 d. 6 h. = one year.
× by 5 and 3 for 15.
1826 6=five years.
3
5478 18=fifteen years.

Continued.

		d.	h.
One thousand years,	=	365250	
Eight hundred years,	=	292200	
Fifteen years,	=	5478	18
1815 years,	=	662928	18

LESSON 12.

When a cannon ball flies at the rate of 1 mile in 7½ seconds, in what time will it fly 1¼ mile? Ans. 9.375 sec.

4)7.5 seconds allowed for 1 mile.
1.875 the fourth of 7.5 for ¼ of a mile.

9.375 for 1¼ mile.

Note.—Twelve calendar months as they are printed in the Almanack make a year, but in the computation of time, we make use of 13 months, each containing 4 weeks, and each week 7 days; for portions of time less than a year.

LESSON 13.

. George Washington, the American patriot, was born 22nd February, 1732, and died 14th of December, 1799; what was his age?

Answer, 67 years, 10 months, 2 weeks, 1 day.

Mode of Operation.

Suppose he had lived till 22nd February,	1800
From 1800 take,	1732
Remain,	. . 68

Now calculate how many months, weeks, and days, there are from the 14th of December, to the 22nd of February following, and subtract them from 68 years.

December,	17 days,
January,	31
February,	21

yr.	mo.	w.	d.
68	0	0	0
	2	1	6
67	10	2	1

7)69 days.
4) 9 w. 6 d.
2 mo. 1. w. 6 d.

MOTION.

60 seconds, marked ″	make 1 minute,	′
60 minutes,	1 degree,	°
30 degrees,	1 sign,	S.

12 signs or 360 degrees, the whole great circle of the Zodiac.

This table is of but little use to boys in common schools; it belongs to the higher orders of men in science, who are studying astronomy. However, a table like the following might be useful to boys, especially to those who intend to learn the art of surveying; but, as instruments and delineations of triangles, circles, &c. are necessary when we are working in rules of this kind, I shall only insert a few useful problems for the practical surveyor, and pass on to Reduction of Money.

SURVEYOR's TABLE.

60 seconds, ″	make 1 minute,	′
60 minutes,	1 degree,	°
90 degrees.	1 quadrant,	Q.

4 quadrants 1 full and complete circle.

1. *How to find a true corner, or to run a direct line from one known object to another, when there is a variation of compass.*

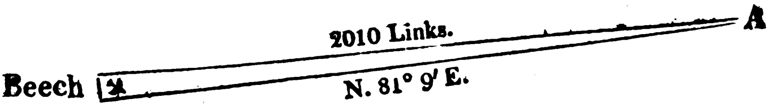
Suppose we begin at A, and run S. 82° W. 20 chains and 10 links, wishing to hit a beech corner tree; but by variation of compass, come out 30 links northerly from the corner; how many minutes variation are there? Answer, 51 minutes.

Therefore the line must be retraced N. 81° 9′ E. from the beech tree to the place of beginning.

RULE.

As the distance run, is to 57°.3; So is the 30 links, to the variation required.	Multiply 57.3 degrees by 30 links and divide that product by the distance run, viz. 20 ch. 10 L. or 2010 links, the quotinet will be the answer.

Here note: If the divisor cannot be contained in the product, multiply by 60 to reduce the product into minutes; then divide, and the quotient will be the answer in minutes.



OPERATION.

57.3 degrees, the second term or multiplicand.
30 links, the third term or multiplier.

1719.0
60 minutes in a degree.

2010)103140.0(51 minutes variation.
10050

..2640 — 82° 00 course run.
2010 — 51 variation deducted.

.630 — 81 09 true course at present.

Here the remainder is omitted, because we cannot run to a fractional part of a minute.

RULE FOR PROOF.

As the sum of the hypothenuse and half the longest leg, is to 86 degrees; so is the shortest leg, to its opposite angle.

But in this case, the lines run so near a parallel direction with each other, that there is no material difference in their length; therefore we add half the base to the whole base, and call it equal to the hypothenuse and half the longest leg; or we consider the hypothenuse and base of equal length.

OPERATION.

86 degrees, the second term or multiplicand.
30 links, the third term or multiplier.

2580
60 minutes in a degree.

154800 minutes for a dividend.

Continued.

2010 links, distance run.
1005 half the same.

3015 for a divisor: the quotient will be the proof in minutes.
3015)154800(51 minutes variation, or proof.
15075

..4050
3015

1035

NATURAL RADIUS.

How to find Natural Radius.

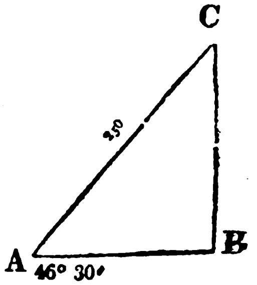
RULE.

1. Take the opposite angle of the side sought, and divide 4 times the square of its complement to 90 degrees, by 300 added to 3 times the said complement.

2. Add the quotient to said angle, their sum will be natural radius.

EXAMPLE.

In the following figure or triangle, the hypothenuse A C, and the angle at A, are given to find the side B C.



90° 00′
46 30

43 30 complement of 46.30
43 30=43.5 degrees.
43.5

2175
1305
1740

1892.25 square of the complement.
4

7569.00 four times the square for a dividend.

Continued.

43°.5 the complement of 46° 30′.
3

130.5 three times the complement.
300. artificial number to be added.

430.5 for a divisor.

430.5)7569.00(17.55 quotient.
4305 46.5 the angle.

32540 64.05 natural radius.
30135

. 24050
21525

. 25250* decimal annexed.
21525

. 3725

As natural radius,	64.05
is to the hypothenuse,	250
So is the angle at A,	46.5
to its opposite leg B C.	

64.05 : 250 : : 46.5
250

2325
930

64.05)11625.000*(181.4 the leg B C.
6405

52200
51240

.. 9600
6405

31950
25620

. 6330

This rule will prove true from 1 degree to 90.

---

* Decimals annexed.

REDUCTION OF MONEY.

The denominations of English money are inserted on Card No. 12.

LESSON 1.

In £2691 13*s.* 2*d.* how many pence? Ans. 645998*d.*

OPERATION.

2691 pounds 13*s.* 2*d.*
20 shillings in a pound,

53833 *s.*
12 pence in a shilling.

645998*d.*

When multiplying by 20, add in the 13*s.* when multiplying by 12, add in the 2*d.*

LESSON 2.

In 87600 pence, how many pounds? Ans. 365 pounds.

OPERATION,

87600÷12
= 7300÷20
= 365

12)87600
2|0)730|0
£ 365

LESSON 3.

In £916 10*s.* 9*d.* 3*q.* how many farthings? Answer, 879879*qrs.*

OPERATION.

£.	*s.*	*d.*	*q.*
916	10	9	3
20			

18330*s.*
12

219969*d,*
4

879879 *qrs.*

916 × 20 + 10 = 18330 × 12 + 9 = 219969 × 4 + 3 = 879879.

LESSON 4.

In £77 14*s.* 7*d.* 2*q.* how many half-pence? Answer, 37311 half-pence.

OPERATION.

£	*s.*	*d.*	*q.*
77	14	7	2

20*s.* in a pound.

1554 shillings.
12*d.* in a shilling.

18655 pence.
2 *qrs.* in a half-pence,

37311 half-pence,

LESSON 5.

In 879879 farthings, how many pounds? Answer, £916 10*s.* 9*d.* 3*qrs.*

OPERATION.

4*q.*=1*d.* 4)879879 farthings.
12*d.*=1*s.* 12)219969 3*q.* over.
20*s.*=1£. 2|0)1833|0 9*d.* over.
£ 916 10*s.* over.

LESSON 6.

In 37311 half-pence, how many pounds? Answer, £77 14*s.* 7*d.* 2*qrs.*

OPERATION.

2)37311 half-pence.
12)18655 1 half-penny over
2|0)155|4 7*d.* over. [or 2*q.*
£77 14*s.* over.

LESSON 7.

In £160 15*s.* 6*d.* how many six-pences ? Answer, 6431 six-pences.

OPERATION.

£160 15 6
20

3215 shillings.
2 six-pences in a shil.

6431 six-pences.

LESSON 8.

In £194 10*s.* 8*d.* how many groats ? Ans. 11672 groats.

OPERATION.

£194 10 8
20

3890 shillings.
3 groats in a shilling.

11672* groats in all.

NOTE.—Four pence make 1 groat.

* 8*d.*=2 groats added.

LESSON 9.

In £ 272 12*s.* 6*d.* how many two-pences? Ans. 32715.

OPERATION.

£ 272 12 6
20

5452 shillings.
6 two-pences in a shil.

32715 two-pences in all.

NOTE.—The 6d. make 3 two-pences which are added in the last product.

LESSON 10.

In 6431 six-pences, how many pounds? Answer, £ 160 15*s.* 6*d.*

OPERATION.

2)6431 six-pences.
2|0)321|5*s.* 1 six-pence over.
£ 160 and 15*s.* 6*d.* over.

LESSON 11.

In 35016 groats how many pounds ? Answer, £ 583 12*s.*

OPERATION.

3)35016 groats.
2|0)1167|2 shillings.
£ 583 12*s.*

LESSON 12.

In 1678 dollars of 7*s.* 6*d.* each, how many six-pences ? Answer, 25170 six-pences.

1678 dols.
15 six-pences=7*s.* 6*d.*

8390
1678

25170

LESSON 13.

In 987 French crowns, how many pieces of 5 cents each? Ans. 21714 pieces.

OPERATION.

1 crown = 110 cents × 987 = 108570 ÷ 5 = 21714.

987 crowns.
110 cents in a crown.

5)108570 cents.
21714 pieces.

LESSON 14.

In 728 dollars, N. Jersey currency, each 7*s.* 6*d.* how many pence and farthings? Ans. 65520*d.* 262080 *qrs.*

728 dolls.
15 six-pences each.

3640
728

10920 six-pences.
6

65520 pence.

65520 pence.
4 *qrs.* in 1*d.*

262080

LESSON 15.

Reduce 728 dollars, New-York currency, to pence and farthings, allowing each dollar to consist of 8 shillings. Make it 69888*d.* 279552 *qrs.*

OPERATION.

728×8=5824*s.*×12=69888*d.* ×4 = 279552 *qrs.*

728 dollars.
8*s.* a dollar.

5824*s.*
12

69888*d.*
4

279552 *qrs.*

LESSON 16.

In 279552 farthings how many dollars of 8*s.* each? Ans. 728 dollars.

OPERATION.

279552÷4 =
69888*d.* ÷ 12
= 5824*s.* ÷ 8
= 728 dolls.

4)279552
12) 69888
8) 5824
728

LESSON 17.

Reduce 44871 farthings into pounds. *Dil.*

Make it £46 14 9 3

OPERATION.

4)44871
12)11217*d.* 3 qrs. over.
2|0) 93|4*s.* 9*d.* over.
£ 46 14*s.* over.

LESSON 18.

A tenant was behind with his landlord for 16 years' rent at £ 5 10*s.* a year; how much was the debt? Ans. £ 88. *Dil.*

OPERATION.

£ 5 10
4

22 0 for 4 years.
4

£ 88 for 16 years.

LESSON 19.

£ 34 17 divided between 17 men, how much is that a piece? Ans. £2 1. *Dil.*

£ 34 17÷17=£2 1*s.*

17)34 17(2£.
34

17)17(1*s.*
17

LESSON 20.

A merchant had £ 102 12*s.* currency of New-York, which sum he exchanged for pieces of silver containing 5 cents, 10 cents, 25 cents, 50 cents, and 100 cents; he exacted an equal number of each: what was that number?

Answer, 135.

OPERATION.

5+10+25+50+100=190 for a divisor.
£ 102 12=256 dols. 50 cents for a dividend.

EXPLANATION.
256 dols. 4*s.*
= 256 dols. 50 cents,
or 25650 cents,
for a dividend.

£ 102 12
20
8)2052
256 dols. 4*s.* over,
or, 25650 cents.

190)25650(135 the number [sought.
190
.665
570
.950
950

PROOF.
Pieces 135× 5,= 675 cts.
× 10,= 1350
× 25,= 3375
× 50,= 6750
×100, =13500
25650 cts.
or 256 dols. 50 cents.

LESSON 21.

In 50 English guineas, how many dollars?

Answer, 233 dols. 35 cents.

OPERATION.

23335 cents =
233 dols. 35 cents.

466.7 cents a guinea.
50 guineas.
23335.0 cents.

LESSON 22.

In 100 French guineas, how many dollars?

Answer, 459 dols. 80 cents.

OPERATION.

45980 cents =
459 dols. 80 cents.

459.8 cents 1 guinea.
100 guineas.
45980.0 cents.

LESSON 23.

In 100 livres of 18.5 cents each, how many dollars?

Answer, 18 dols. 50 cents.

OPERATION.

18.5 cents 1 livre.
100 livres.
1850.0 cents.

1850 cents =
18 dols. 50 cents.

LESSON 24.

In 445 guilders of 39 cents each, how many dollars?

Answer, 177 dols. 45 cents.

OPERATION.

455 guilders.
39 cents in a guilder.
4095
1365
17745 cents.

17745 cents.
= 177 dols. 45 cents.

LESSON 25.

In 1923 marks of Germany, how many dollars?

Answer, 641 dollars.

A mark = $33\frac{1}{3}$ cents or one third of a dollar. 1923 ÷ 3 = 641 for dollars.

LESSON 26.

Reduce £ 578 sterling of Great Britain into dollars. Make it 2566 dollars, 32 cents.

OPERATION.

578 pounds.
444 cents in 1 pound.
2312
2312
2312
256632 cents.

256632 cents =
2566 dols. 32 cents.

END OF PART EIGHTH.

INTRODUCTION TO ARITHMETIC,

PART IX.

CONTAINING,

PROPORTION, INTEREST, REBATE, BARTER, LOSS AND GAIN, SINGLE AND DOUBLE FELLOWSHIP.

PROPORTION.

PROPORTION, is commonly called the *Rule of Three*; because a question or problem in this rule, has three numbers given to find a fourth; and in ancient times it was called "THE GOLDEN RULE OF THREE," by reason of its usefulness: For, by this rule, we can solve many crafty, critical, and astonishingly curious questions, which could not be done without knowing this method in calculation.

EXAMPLE.

If 2 bushels of corn cost 6 shillings, what will 4 bushels cost?

RULE.

Multiply the second and third numbers together, and divide their product by the first; the quotient will be the fourth number or answer.

Operation.

```
b.     s.     b.
2  :   6  ::  4
              6 second number.
             ——
First number, 2)24 product.
Quotient,       12s. answer.
```

This answer can be calculated mentally, that is, by the head, and very soon too; but such easy examples are most like-

KEY TO CARD No. 31.

ly to inspire a learner with the knowledge of new rules, whereby he can solve problems of a more difficult nature.

These numbers are called terms ; the first term, the second term, the third term, and the fourth term. See Lesson A. Card 31.

In stating a question, we place a colon between the first and second term, two colons between the second and third, and if the fourth number be known, we place one colon between the third and fourth, thus, 2 : 6 : : 4 : 12 and we read them as follows ; as 2 are to 6 ; so are 4 to 12, that is, 2 bear the same proportion to 6, as 4 do to 12. See Lesson B. Card 31.

Let us scan another example: If 2 bushels of oats cost 4 shillings, what will 7 bushels cost ?

Here 2 bushels cost 4 shillings, which is at the rate of 2 shillings a bushel; consequently, 7 bushels will cost 14 shillings, because 7 times 2 are 14; thus the first term 2, bears the same proportion to the second, as the third term 7, does to the fourth.

How to know which is the first, second, and third term, before a question is stated.

The first term is a supposition, as, "*If* 2 *bushels cost*," or, "*Suppose* 2 *bushels cost.*"

The second term is that which bears the same name of the answer, as, "4 *shillings.*"

The third term is of the same name of the first, and expresses a demand, by asking a question, as, "*What will* 7 *bushels cost?*"

Here our ideas are naturally led to shillings for the fourth term or answer, because the second term was in shillings.

And if the *second* term had been in pence, or gallons, or quarts, or feet, or inches, &c. the fourth term would be of the same name as the *second.*

KEY TO CARD No. 31.

EXAMPLE.

If 2 shillings will buy 4 quarts of vinegar, what quantity will 8 shillings buy?

In this case the second term is in quarts, and the answer must be likewise in quarts.

Many more particulars which belong to the rule of three, must be taken into consideration; but we will pass on with a few lessons before the mind is confused with too much criticism.

LESSON 1.

If 5 pounds of butter cost 80 pence, what will 9 pounds cost? Answer, 12 shillings.

OPERATION.

lb. d. lb.
5 : 80 : : 9 to a fourth number.

That is to say, as 5 lb. are to 80*d.*; so are 9 lb to a fourth number.

Multiply the second and third terms together and divide by the first. The quotient or answer will be in pence.

Divide those pence by 12 to reduce them into shillings.

80 the second term.
9 the third term.

First term, 5)720
12)144 pence or fourth term.
12 shillings.

LESSON 2.

If 5 pounds of butter cost 80 pence, how much will 1 pound cost? Answer, 16 pence.

lb. d. lb.
5 : 80 : : 1 to a fourth number.

That is to say, as 5 lb. are to 80 pence; so is 1 lb. to a fourth number or answer.

Here, the third term being 1, it makes multiplication useless; therefore only divide the second term by the first, the quotient will be the answer.

KEY TO CARD No. 31.

Operation.

5)80
  16 *d.*

As the second term was in pence, so the answer is in pence.

LESSON 3.

If 1 lb. butter cost 16 pence, what will 5 lb. cost?

Answer, 80 pence.

In this case division is unnecessary, because the first term is 1; therefore a multiplication of the second and third term, will give the answer.

lb. d. lb.
1 : 16 : : 5 to a fourth number.

That is, as 1 lb. is to 16*d.* so are 5 lb. to a fourth number; and, as the second term is in pence, so the answer will be in pence likewise.

16 second term,
 5 third term.

80 fourth term, or answer.

LESSON 4.

Bought 8 pieces of chints for £57 12*s.* what must I pay for 12 pieces at that rate? Answer, £86 8*s.*

Reduce the sum £57 12 into shillings, viz. 1152*s.*

Then say,

pieces. s. pieces.
8 : 1152 : : 12 to a fourth number.

Read the statement thus; as 8 pieces are to 1152 pence, so are 12 pieces to a fourth number.

Operation.

1152 second term.
  12 third term.

8)13824
  1728 shillings, or fourth term.

KEY TO CARD No. 31.

Here remember, that, when the fourth term is in a low denomination, it must be reduced to its proper quantity; as, pints to gallons; inches to feet; pounds to hundreds; and, as in this case, shillings to pounds. Therefore divide the sum 1728 shillings, by 20, the answer will be £ 86 8*s*.

2|0)172|8
£ 86 8*s*.

LESSON 5.

Suppose the aforesaid pieces of chints contain 432 yards in the whole, and cost £ 86 8; how much is that a yard?
Answer, 4 shillings.

Here the third term being 1, division only is necessary.

£ 86 8*s*.=1728*s*. yds. s. yd.
432 : 1728 : : 1

Read thus, "as 432 yards are to 1728 shillings; so is 1 yard to a fourth number."

Operation.

432)1728(4*s*. the Answer.
1728
————
. . . .

LESSON 6.

If 6 horses eat 9 bushels of oats, how much will 24 horses eat in the same time? Answer, 36 bushels.

Operation.

h. b. h.
6 : 9 : : 24 third term.
Multiply by 9 the second term.
————
Divide by 6, 6)216
36 bushels for answer.

But, some of those particulars before mentioned, must come under consideration: In the Rule of Three, there are two sorts of proportion; *direct*, and *inverse*.

That part which we have already scrutinized, is direct proportion; yet we know not *why* it is direct. In every

KEY TO CARD No. 31.

problem[*] there are certain signs by which we can know *direct* from *inverse* proportion.

1st. When *more* requires *more*, the proportion is direct.

If the third term be greater than the first, and the nature of the question shows that the answer must be greater than the second term, then *more* requires *more.*

EXAMPLE.

If one bushel of salt cost 8 shillings, what will 2 bushels cost?

Here the third term is greater than the first, and we readily perceive that the answer must be greater than the second term.

AGAIN,

2nd. When *less* requires *less*, the proportion is direct.

If the third term be less than the first, and the nature of the question shows that the answer must be less than the second, then *less* requires *less.*

EXAMPLE.

If 4 pounds of sugar cost 6 shillings, what will 1 pound cost?

Here the third term is less than the first, and the nature of the question shows that the answer must be less than the second.

Let us become masters of *direct* proportion, and then contrive some rules whereby we can distinguish that which is *inverse.*

LESSON 7.

If buttons cost 50 shillings a gross, what will one dozen cost? Answer, 50 pence.

NOTE.—144 make one common gross; and whatsoever number of shillings any articles cost by the gross, so many pence they will cost by the dozen; and whatever number of shillings any articles cost by the dozen, so many pence will be the price of one.

---

[*] Problem, a question, a mathematical question.

KEY TO CARD No. 31.

OPERATION.

b. *s.* *b.*
144 : 50 :: 12
50
—
600*s.*
Pence in a shilling, 12
—
First term, 144)7200(50*d.*
720
—
...0

In this last question, the third term is less than the first, and the nature of the question requires the fourth term or answer to be less than the second: Therefore less requires less.

LESSON 8.

If a barrel of wine containing 32 gallons cost £12 16 8 what will a pipe of 120 gallons cost? Answer, £48 2 6.

Reduce the given sum into pence.

£12 16 8
20
—
256
12
—
3080 pence.
g. *d.* *g.*
32 : 3080 :: 120

Let us query what proportion this lesson is in. Is the third term greater than the first? we see it is; does the nature of the question show, that 120 gallons, the third term, will cost more than 32 gallons? If so, the proportion is direct.

3080, 2d. term.
120, 3d. term.
—
1st. term, 32)369600(11550*d.*
32 [for Ans.
—
. 49
32
—
176
160
—
. 160
160
—
...0

If the second term be in pence, the answer or fourth term will be in pence. Reduce them to pounds.

12)11550 pence.
2|0) 96|2*s.* 6*d.* over.
£ 48 2*s.* over.

Cards are omitted till Compound Proportion.

LESSON 9.

If 32 gallons of wine cost £ 12 16 8 how much is that a gallon?

Answer, £0 8*s.* 0*d.* 1*qr.*

As 32 gal.: £ 12 16 8 :: 1 gal. to a fourth number.

That is to say, as 32 gallons are to £ 12 16 8, so is 1 gallon to a fourth number

Note.—As the third term is one, so multiplication is needless, and division only is necessary; therefore divide the second term £ 12 16 8 by 32 the first term. Divide as in compound division, by 4 and by 8, or by 8 and by 4.

	£.	s.	d.	q.	
8)	12	16	8		
4)	1	12	1		
	0	8	0	1	fourth term, or answer.

Proof of Lesson 8 and 9, by Compound Multiplication.

Multiply £ 0 8 0 1 by 120 gallons. Multiply by 10 and by 12.

£0	8	0	1
			10
4	0	2	2
			12
£48	2	6	0

LESSON 10.

If a servant procure 37½ cents a week, how much will he gain in 52 weeks? Answer, 19 dol. 50 cents.

w. cents. w.
1 : 37.5 :: 52
52
750
1875
1950.0 cents.

½ cent = .5 of a cent.
1950 cents = 19 dol. 50 cents.

LESSON 11.

When a man earns 125 dollars a year, that is, in 365 days, how much may he spend each day and lay up 53 dollars 82½ cents at the year's end? Ans. 19½ cents each day.

Directions.

In the first place annex two ciphers to 125 to reduce the dollars to cents, thus, 12500 cents.

Subtract 53 dol. 82½ cents or 5382.5

Cents remain, 7117.5

This sum 5382.5 cents is, as if it were taken out from the whole sum, and deposited in the chest.

Then there remain 7117.5 cents for spending money to be divided into 365 parts.

$. cents. $.
365 : 7117.5 : : 1
365)7117.5(19.5
365
———
3467
3285
———
.1825
1825

EXPLANATION.

As 365 days are to 7117.5 cents, so is 1 day to 19.5 cents.

or,

If 365 days give 7117.5 cents, what will 1 day give?

INVERSE PROPORTION.

We must now study *inverse* proportion. When the third term is greater than the first, and the nature of the question requires the fourth term to be less than the second, then the proportion is *inverse*. This is called *more* requires *less*.

EXAMPLE.

If 4 men can harvest a field of wheat in 2 days, in what time can 8 men do the same work? Answer, 1 day.

RULE.

Multiply the first and second terms together and divide the product by the third, the quotient will be the fourth term or answer.

OPERATION.

men. d. men.
4 : 2 : : 8
2
—
8)8(1 day, answer.

In this example the fourth term is as much less than the second, as the third is greater than the first: For, 8 is twice the quantity of 4, but 1 is only half the quantity of 2. Therefore this sort of proportion is properly named *inverse*; or, *indirect*, or, if you please, *contrary*.

AGAIN.

When the third term is less than the first and requires the fourth to be greater than the second, the proportion is also *inverse.*

This is called *less* requires *more.*

EXAMPLE.

If 12 persons in a family have provisions for 36 days, how many persons will the same provisions serve 18 days?

Answer, 24 persons.

d. p. d.
36 : 12 : : 18 to a fourth number, 24.

That is to say, if 36 days require 12 persons to devour the food, what number of persons will 18 days require?

Here the third term is less than the first and requires the fourth to be contrary, that is, as much greater than the second.

For, the third term is only half the quantity of the first, but the fourth term is double the quantity of the second.

OPERATION.

```
    36 first term.
    12 second term.
   ---
18)432(24 persons, Answer.
   36
   ---
   .72
    72
   ---
    ..
```

LESSON 12.

If 864 feet in length of plank 12 inches wide will floor a room, how much in length will be required when the planks are 18 inches wide?

Answer, 576 feet in length.

OPERATION.

```
in. w.  f. l.   in. w.
  12  :  864  : :  18
          12
        ———
   18)10368(576
        90
        ——
        136
        126
        ———
        108
        108
```

Here we say, if 12 inches wide require 864 feet in length, what will 18 inches wide require?

The third term is greater than the first, and requires the fourth to be less than the second.

LESSON 13.

If 500 dollars draw 35 dollars of interest in 12 months, what sum will give the same interest in 3 months?

Answer, 2000 dollars.

OPERATION.

```
 mo.  dol.   mo.
 12 : 500 : : 3
      12
     ———
  3)6000(2000
```

If 12 months require 500 dols. 3 months will require four times that sum.

LESSON 14.

If 24 horses will eat 36 bushels of oats in 1½ day, what number of horses will eat the same quantity in 3 days?

Answer, 12 horses.

```
 d.    h.    d.
1.5 : 24 : : 3
      1.5
      ——
      120
      24
     ——
  3)36.0(12
```

1½ day=1.5 day.

If 1.5 day require 24 horses to devour 36 bushels, then 3 days will require a less number.

LESSON 15.

If 56 pounds of butter cost £0 18 8 what is that a pound?

Answer, 4 pence.

```
lb.   d.    lb.
56 : 224 : : 1
  56)224(4
      ——
      ...
```

18s. 8d. = 224 pence.

The third term is less than the first and requires the fourth to be less than the second. This is less requires less or direct proportion.

LESSON 16.

If a pound of tobacco cost 18*d.* what will 300 weight of 112 lb. each come to? Answer, £25 4*s.*

Reduce the tobacco to pounds for a third term.

lb. d. lb.
1 : 18 : : 336
18

2688
336

6048

112 lb.×3=336 lb.
The fourth term is 6048 pence=£25 4*s.*
12)6048*d.*
2|0)50|4
£25 4*s.*

LESSON 17.

If 1 pound of sugar cost 9 pence, what is the cost of 17 hundred, 2 quarters? Answer, £73 10*s.*

cwt. qrs.
17 2
4 qrs. in a hundred.

70 quarters.
28 lb. each.

1960 lb.

lb. d. lb.
1 : 9 : : 1960
9

12)17640
2|0)147|0
£73 10*s.*

LESSON 18.

How much in length that is $\frac{3}{4}$ of a yard wide will make a piece 1 yard wide and 2 yards long? Ans. $2\frac{1}{2}$ yds. 6 in.

There are 8 quarters in a piece 2 yards long, and at the same time the piece is 4 quarters wide. Then say, if 4 qrs. wide, require 8 qrs. in length, what will 3 qrs. wide require? This appears to be less requires more, or inverse proportion.

qr.w. *qr.l.* *qr.w.*
4 : 8 : : 3
4

3)32
10 and 2 qrs. over = 18 inches.
3 in 18? 6 times. 10 qrs. 6 in. = $2\frac{1}{2}$ yds. 6 inches.

LESSON 19.

If when wheat is at 175 cents a bushel, the baker gives 22 ounces Avoirdupois in a loaf for 12½ cents, how many ounces can he give in the loaf without loss, when the wheat is at 150 cents a bushel?

Answer, 25 *oz.* 10 *drams.* $\frac{100}{150}$ *of a dram.*

cents. *oz.* *cents.*
175 : 22 : : 150

In this case the third term is less than the first, and requires the fourth to be greater than the second: For, the cheaper the wheat is, the larger the loaf can be for the same money. And if the third term be less than the first, and requires the fourth to be greater than the second, then, less requires more; therefore the proportion is inverse.

OPERATION.

175 cents the 1st term.
22 oz. the 2nd term.
350
350
150)3850(25 oz.
300
.850 continued.

850 continued.
750
100 ounces remain.
16 drams in an ounce.
150)1600(10 drams.
1500
.100 $\frac{100}{150}$ of a dr. rem.

LESSON 20.

If I borrow 540 dollars for 160 days, how long must I lend 800 dollars, to pay the interest?

Answer, 108 days.

dol. d. dol.
540 : 160 : : 800
540
64
80
8|00)864|00
Ans. 108 days.

If 540 dollars require 160 days to make a sum of interest, then 800 dollars will require a less time. This is more requires less.

LESSON 21.

If a yard of cambric cost 12*s.* what will 4 pieces cost, each piece containing 20 yards? Answer, £48.

yd. s. yds.
1 : 12 : : 80
80
——
2|0)96|0*s*.
£48

4 pieces×20=80 for the third term. The third term is greater than the first, and requires the fourth to be greater than the second. This proportion is of more requires more; consequently, direct.

LESSON 22.

If a dozen caseknives cost 4*s*. 4*d*. what will 49392 cost?

Answer, £891 16*s*.

k. d. k.
12 : 52 : : 49392
52*d*. second term or 4*s*. 4*d*.
——
98784
246960
——
12)2568384
12)214032 pence for answer.
2|0)1783|6
£891 16*s*.

LESSON 23.

If a board be 8 inches wide, how much in length will make a foot square? Answer, 18 inches.

in w. in l. in w.
12 : 12 : : 8
12
——
8)144
18 in.

Here we say, if 12 inches in width, require 12 inches in length, to make a foot square, then 8 inches wide will require more in length. Therefore as the third term is less than the first, and requires the fourth to be greater than the second, less requires more.

We will now make a memorandum which must be learned so perfectly, that it will always be ready in the mind; that is to say,

DIRECT PROPORTION is known by, *more requires more*, or, *less requires less*.

AND,

INVERSE PROPORTION is known by, *less requires more*, or, *more requires less*.

However nice these distinctions may appear, they must be observed by all expert arithmeticians.

LESSON 24.

A merchant has owing to him £ 1000, and the debtor agrees to pay 12*s.* 6*d.* on the pound; how much will be the payment? Answer, £ 625.

```
£.    s.       £.
1  :  12.5 : : 1000
               1000                12s. 6d.=12.5s.
               ————
   2|0)1250|0.0 shillings for the fourth term.
      £ 625  Answer in pounds.
```

The third term is greater than the first, and requires the fourth to be greater than the second.

LESSON 25.

If a pint of wine cost 10*d.* what will 189 gallons cost? Answer, £ 63.

```
pints.  d.     pints.           8 pints make 1 gallon.
  1  :  10 : : 1512             Multiply 189 gals. by 8.
          12)15120*d.                      8
            2|0)126|0                    ————
               £ 63                    1512 pints.
```

LESSON 26.

A grocer bought 3 hogsheads of sugar, each 10 cwt. 3 qrs. 12 lb. gross, tare 26 lb. in each hogshead, at 7*d.* 2*q.* a pound; what was the price of the 3 hhds.? Answer, £ 111 11*s.* 3*d.*

NOTE.—Tare is an allowance for waste.

```
26 lb. tare in each hogshead.
 3 hhds.
——
78 lb. of tare in the whole, which must be subtracted
```

from the gross, the remainder will be neat.

```
cwt.   qrs.   lb.
 10     3     12  in each hogshead.
  4               quarters 1 hundred.
 ——
 43 quarters.
```

Continued.

---

* A cipher annexed, multiplies by 10.

43 quarters.
28 lb. in a quarter.

356
86

1216 pounds in 1 hogshead, gross.
3 hhds.

3648 lb. gross in 3 hogsheads.
78 lb. tare in the whole.

3570 lb. neat, after the tare is deducted.
7*d.* 2*q.* = 30 farthings.

Now state the question.

lb. q. lb.
1 : 30 :: 3570
30

4)107100*q.*
12) 26775*d.*
2|0) 223|1*s.* 3*d.*
£111 11*s.*

As the second term is in farthings, so the fourth term must be farthings; divide them by 4, by 12 and 20, to make pounds.

LESSON 27.

If a cistern of water in a city be sufficient to supply 615 persons 30 days, how many must move out that the water may last 45 days? Answer, 205.

REMARKS.

If 615 persons will use the water in 30 days, then it will require a less number in 45 days.

Say, if 30 days require 615 persons, what number will 45 days require? 45 will require 410 persons. Subtract 410 from 615, the difference will be the number to move out.

d. p. d.
30 : 615 :: 45
30

45)18450(410 persons.
180

..45
45

..0

615 persons for 30 days.
410 for 45 days.

205 the difference, which number must move out.

LESSON 28.

If 17 cwt. 3 qrs. 17 lb. tobacco, cost £133 13*s.* 4*d.* how much is that an ounce?

Answer, 1*d.*

cwt. 17 3 qrs. 17 lb.
4

71 qrs.
28 lb. in a qr.

585
142

2005 lb.
16 oz. in a pound.

12030
2005

32080 ounces.
£ 133 13 4
20

2673
12

32080 *d.*

oz. d. oz.
32080 : 32080 : : 1
32080)32080(1*d.*
32080

LESSON 29.

A piece of cloth cost £ 16 10*s.* the price of a yard was 15*s.*; how many yards were there in the piece?

Answer, 22 yds.

£ 16 10
20

330*s.*

If 15*s.* will buy 1 yard, how many will 330*s.* buy?

s. yd. s.
15 : 1 : : 330
15)330(22
30

30

LESSON 30.

If 270 dollars a year, will supply 12 persons in a family with wheat at 187½ cents a bushel, how many persons will the said 270 dollars supply with bread, when wheat is at 125 cents a bushel?

Answer, 18 persons.

cents. P. cents.
187.5 : 12 : : 125
12

125)2250.0(18 persons.
125

1000
1000

LESSON 31.

If 100 cents make 4*s.* 6*d.* or 54 pence sterling, what sum will 100 dollars make in sterling currency?

Answer, £22 10*s.*

cents. d. cents.
100 : 54 : : 10000
1|00)5400|00
12)5400*d.*
2|0) 45|0*s.*
£ 22 10*s.*

Sterling is the currency of Great Britain.

Halifax and Canada currency has 5*s.* to the dollar.

LESSON 32.

If 4*s.* 6*d.* or 54 pence sterling make 100 cents, what sum will £ 45 9 sterling make in cents?

Ans. 20200 cts. or 202 dol.

d. cents. d.
54 : 100 :: 10908
54)1090800*(20200 cents.
108
——
..108
108
——
...00

£ 45 9
20
——
909
12
——
10908*d.*

LESSON 33.

If 100 cents make 60 pence Halifax currency, how much will 100 dollars make in Halifax? Answer, £ 25.

OPERATION.

cents. d, cents.
100 : 60 : : 10000
×60 by 10000, then÷by 100
Thus, 1|00)6000|00
12)6000 *d.*
2|0) 50|0*s.*
£ 25

NOTE.—In England a dollar contains	4	6
In South Carolina and Georgia,	4	8
In Nova Scotia and the Canadas,	5	0
In New England,† Virginia, Kentucky, and Tennessee,	6	0
In New Jersey, Pennsylvania, Delaware, and Maryland,	7	6
In New-York and North Carolina,	8	0

NOTE.—But for about thirty years past, North Carolina has estimated the dollar at ten shillings.

LESSON 34.

If 5*s.* make 100 cents, how many dollars will £ 52 15*s.* make? Ans 211 dollars.

s. cents. s.
5 : 100 : : 1055
5)105500
21100

£ 52 15
20
——
1055

LESSON 35.

If 100 cents make 6*s.* or 72*d.* New England currency, how much will 100 dollars make in New England currency?

c. d. c. Ans. £ 30.

100 : 72 : : 10000
1|00)7200|00
7200*d.*

12)7200*d.*
2|0) 60|0
£30

---

* Two ciphers annexed to multiply by 100.

† New England is composed of the following states, viz. Vermont, New Hampshire, Commonwealth of Massachusetts, Rhode Island and Connecticut.

LESSON 36.

If 6*s.* make 100 cents, how many dollars will £216 18*s.* make? Ans. 723 dolls.

s. c. *s.*
6 : 100 : : 4338
6)433800
72300

£216 18*s.*
20
4338*s.*

LESSON 37.

If 100 cents make 8*s.* New-York currency, what sum will 100 dollars make?

Ans. £40.

c. s. c.
100 : 8 : : 10000
1|00)800|00
2|0)80|0*s.*
£40

LESSON 38.

If 8*s.* make 100 cents, how many dollars are in £455 12*s.*? Ans. 1139 dols.

s. cts. s.
8 : 100 : : 9112
8)911200
113900 cts.

£. *s.*
455 12
20
9112*s.*

LESSON 39.

If 100 cents make 7*s.* 6*d.* Pennsylvania currency, what sum will 100 dollars make?

Ans. £37 10*s.*

OPERATION.

7*s.* 6*d.*=90*d.*
cts. d. cts.
100 : 90 : : 10000
1|00)9000|00
12)9000*d.*
2|0)75|0
£37 10*s.*

LESSON 40.

If 90 pence make 100 cts. how many dollars will £35 12*s.* 6*d.* make?

Ans. 95 dollars.

d. cts. d.
90 : 100 : : 8550
9|0)855000|0
9500 cts.

£. s. d.
35 12 6
20
712*s.*
12
8550*d.*

LESSON 41.

If 100 cents make 4*s.* 8*d.* in South Carolina and Georgia, what sum will 100 dollars make? Ans. £23 6*s.* 8*d.*

4*s.* 8*d.* equal 56 pence.
cts. d. cts.
100 : 56 : : 10000
1|00)5600|00
12)5600*d.*
2|0)46|6*s.* 8*d.*
£23 6*s.* 8*d.*

LESSON 42.

If 56*d.* make 100 cents, how many dollars will £21 9*s.* 4*d.* make?

Ans. 92 dollars.

d. cts. d.
56 : 100 : : 5152
56)515200(9200
504
112
112
. . . 00

£. *s.* *d.*
21 9 4
20
429*s.*
12
5152*d.*

COMPOUND PROPORTION.

This is called the Double Rule of Three, or, Rule of Five. In this Rule five terms are given to find a sixth.

EXAMPLE.

If 4 men can reap 16 acres in 8 days, how many men can reap 48 acres in 4 days? Answer, 24 men.

The three first terms form a supposition, the fourth and fifth make a demand, and the sixth gives the answer.

As in simple Proportion, so in this; if more require more, or less require less, it is direct.

And, if more require less, or less require more, it is inverse.

"If the proportion is direct, the sixth term must bear such proportion to the fourth and fifth, as the third term bears to the first and second.

But if the proportion is inverse, then the sixth term must bear such proportion to the fourth and fifth, as the first bears to the second and third, or as the second bears to the first and third."

Rule for stating.

Take those terms which form the supposition in the above example, and begin thus:

1. Let the principal cause of *action* be placed in the first term; as, 4 men :

2. Let that which denotes time, distance, &c. be in the second term; as, 8 days

3. Place the remaining number of the supposition in the third term; as, : : 16 acres.

Then the work will stand thus:

men. d. acres.
4 : 8 : : 16

See Lesson C. *Card* 31.

4. Place the other two terms, which move the question, under those of the same name, thus:

men. d. acres.
4 : 8 : : 16
4 : : 48

See Lesson D. *Card* 31.

KEY TO CARD No. 31.

3. If the blank fall under the third term, then multiply the first and second terms together for a divisor, and the other three for a dividend.

But, if the blank fall under the first or second term, then multiply the third and fourth terms together for a divisor, and the other three for a dividend, the quotient in either case will be the answer.

PROOF IS PERFORMED

By two statings in simple proportion.

OPERATION OF THE AFOREGOING EXAMPLE.

men d. acres.
4 : 8 :: 16
4 :: 48

48 fifth term.
8 second term.
384
4 first term.
1536 a dividend.

16 third term.
4 fourth term.
64 a divisor.

64)1536(24 men.
128
256
256

PROOF OF THE AFOREGOING STATEMENT.

We will suppose that the men reap during the time of 8 days; then say,

If 16 acres : require 4 men :: how many men will 48 acres require?

acres. men. acres.
16 : 4 :: 48
4
16)192(12 men.
16
32

By this operation we find that 48 acres require 12 men if they reap during 8 days.

Now say if 8 days require 12 men :: how many men will 4 days require?

d. men. d.
8 : 12 :: 4
12
4)96(24 men.

In this last statement, the third term is less than the first and requires the fourth to be greater than the second, and shows that less requires more; therefore the proportion is inverse.

LESSON 1.

If 56 bushels of corn will supply 7 persons 4 months, how many bushels will supply 46 persons 10 months?

Answer, 920 bushels.

KEY TO CARD No. 31.

P. mo. bush.
7 : 4 :: 56
46 : 10

Turn and read the rule.

7 first term.
4 second term.

28 divisor.

46 fourth term.
56 third term.

276
230
2576
10 fifth term.

25760 dividend.
28)25760(920 bush.
252

..56
56

..0

Proof of Lesson 1.

In the first place, suppose they are all eating 4 months: then, if 7 persons eat 56 bushels, how much will 46 persons eat?

P. Bush. P.
7 : 56 :: 46
46

336
224

7)2576
368 bush.

By the last operation we find that 46 persons will eat 368 bushels in 4 months.

Then say, If 4 months require 368 bushels, how much will 10 months require?

mo. bush. mo.
4 : 368 :: 10
4)3680
920 bush. for proof.

LESSON 2.

If 8 men have 8 dollars for 4 days' work, how much shall 48 men have for 16 days?

Answer, 192 dollars.

men. d. dol.
8 : 4 :: 8
48 : 16
8 first term.
4 second term.

32 divisor.

48 fourth term.
16 fifth term.

288
48

768
8 third term.

6144 dividend.
32)6144(192 dol.
32

294
288

..64
64

Proof of lesson 2.

Suppose they are all at work 4 days.

KEY TO CARD No. 31.

If 8 men receive 8 dollars, what will 48 men receive. We readily know that they will receive 48 dollars; but in order to trace the different operations of the rule, we will multiply and divide.

men. dol. men.
8 : 8 :: 48
8
8)384
48 dol.

Now say, If 4 days will give 48 dollars, what will 16 days give?

d. dol. d.
4 : 48 :: 16
16
288
48
4)768
Proof, 192 dol.

LESSON 3.

If 10 bushels of oats will supply 18 horses 20 days, how many bushels will serve 60 horses 36 days? Answer, 60 bushels.

h. d. bush.
18 : 20 :: 10
60 : 36

18 first term.
20 second term.
360 divisor.

36 fifth term.
60 fourth term.

2160
10 third term.
21600 dividend.

360)21600(60 bush.
2160
....0

PROOF OF LESSON 3.

Suppose 18 horses are eating for 36 days:

Then, If 20 days' allowance is 10 bushels, how much will be 36 days' allowance?

d. bush. d.
20 : 10 :: 36
20)360(18 bush.
20
160
160

If 18 horses devour 18 bushels, how much will 60 horses devour?

h. bush. h.
18 : 18 :: 60

We know the answer must be 60.

LESSON 4.

When a footman travels 240 miles in 12 days of 12 hours long, in how many days of 16 hours long will he travel 720 miles? Ans. in 27 days.

For distinction, we will mark 12 hour-days and 16 hour-days, thus, 12hd. 16hd. and days we will mark with d only.

Now suppose that 12 hour-days is the principal cause of action and must be the first term.

hd. d. miles.
12 : 12 :: 240
16 : :: 720

KEY TO CARD No. 31,

240 third term.
16 fourth term.

144
24

3840 divisor.

720 fifth term.
12 first term.

8640
12 second term.

103680 dividend.
3840)103680(27 days.
7680

26880
26880

PROOF OF LESSON 4.

If he travel the whole time in days of 12 hours long, how many days will 720 miles require? If 240 miles require 12 such days, how many will 720 miles require?

miles. hd. miles.
240 : 12 : : 720
12

240)8640(36 days of 12 hours
720

1440
1440

Now say, if 720 miles require 36 days of 12 hours each, how many will the same 720 miles require of 16 hours days?

hd. d. hd.
12 : 36 : : 16 inv. prd.
12

432 Dividend.

16)432(27 days for proof.
32

112
112

LESSON 5.

If 8 men have 375 ce
for their hire of 3 days, ho
many days must 20 men wo
for 3750 cents? Ans. 12 da

8 men : 3 days : : 375 cen
20 : : 3750

375 third term.
20 fourth term.

7500 divisor.

3750 fifth term.
8 first term.

30000
3 second ter

90000 dividend.
7500)90000(12 days
90000

PROOF OF LESSON 5.

Suppose the whole mone
must be earned in 3 days, [illegible]
many men will be require

cents. men. cents.
375 [illegible]
8

375)30000(80 me
[illegible]

Now say if 80 men requi
3 days, how many days wi
20 men require?

men. d. men.
80 : 3 : : 20 inve
3

20)240(12 days for proo
240

LESSON 6.

If 4 men have 12 dollars for 3 days' work, how many men will earn 48 dollars in 8 days? Ans. 6 men.

men. d. dol.
4 : 3 : : 12
8 : : 48
48 fifth term.
4 first term.
192
3 second term.
576 dividend.
12 third term.
8 fourth term.
96 divisor.
96)576(6 men.
576
....

PROOF OF LESSON 6.

dol. men. dol.
12 : 4 : : 48
4
12)192
16 men.
$. men. $.
3 : 16 : : 8
3
8)48(6 men.
48
..

LESSON 7.

If 700 dollars gain 24 dollars 50 cents interest in 6 months, how much will 400 dollars gain in 5 years? Ans. 140 dollars.

700 doll. = 70000 cents.
6 mo. = .5 of a year, &c.
cents. yr. cents.
70000 : .5 : : 2450
40000 : 5.
2450 third term.
40000 fourth.
98000000.
5. fifth term.
490000000 dividend.
70000 first term.
.5 second term.
35000.0 divisor.
35|000)490000|000(14000 cts
35 [= 140 dol.
140
140
...000

LESSON 8.

If 296 soldiers eat 1776 pounds of beef in 6 days, how many pounds will 350 men eat in 11 days? Answer, 3850 pounds.

men. d. lb.
296 : 6 : : 1776
350 : 11 : :
296 first term.
6 second term.
1776 divisor.
1776 third term.
350 fourth.
8880
5328
621600
11 fifth term.
6837600 dividend.

Continued.

1776)6837600(3850 lb.
5328

15096
14208

8880
8880

0

LESSON 9.

Proof of Lesson 8.

If 296 soldiers will eat 1776 pounds of beef in 6 days, in how many days will 350 men eat 3850 pounds?

Answer, 11 days.

men.		d.		lb.
296	:	6	::	1776
350	:		::	3850

3850 fifth term.
296 first.

2310
3465
770

1139600
6 second term.

6837600 dividend.
1776 third.
350 fourth.

8880
5328

621600 divisor.
621600)6837600(11 days.
6837600

LESSON 10.

What is the interest of 200 dollars for 3¾ years at 5 per cent. per annum? that is, 5 dollars on the hundred yearly. Ans. 37 dol. 50 cents.

Suppose 100 dollars in 1 year will gain 5 dollars interest, then, how much interest will 200 dollars gain in 3 years and 3 quarters of a year? or, 3.75 years?

For distinction, mark 100 dollars principal, dol. P. and 5 dollars interest, dol. intr.

dol. P.		yr.		dol. intr.
100	:	1	::	5
200	:	3.75		

3.75 fifth term.
5 third term.

18.75
200 fourth

3750.00 dividend.

As the second term is 1, multiplication is needless; therefore 100 is the divisor.

100)3750.00(37.50 dol.= 37 dol. and 50 hundredths of a dollar.
300

750
700

500
500

LESSON 11.

If I lend 74 dollars, and at the end of 6 months receive 76 dollars and 59 cents for principal and interest, at what rate per cent do I receive interest?

Answer, 7 per cent.

We will first note that 74 dollars make the principal, and that the interest added to the principal makes a sum called the amount, viz. 76.59 dollars.

Subtract the principal 74, from 76.59 the amount, the difference 2.59 is the interest.

Then say: If 74 dollars principal in 6 months, will give 2.59 dollars interest, what will 100 dollars principal give in 12 months, or 1 year?

dol. P.		mo.		dol. intr.
74	:	6	: :	2.59
100	:	12	: :	

```
        74 first term.
         6 second.
       ---
       444  divisor.
2.59 third.
 100 fourth.
------
259.00
 12
------
3108.00 dividend.
   444)3108.00(7.00 dol.
       3108
       ----
       ....00
```

This sum of 7 dollars is the rate per cent. per annum, or, by the hundred by the year.

LESSON 12.

What is the interest of 130 dollars for 73 days at 6 per cent. per annum?

Answer, 156 cents.

dol. P.		days.		dol intr.
100	:	365	: :	6
130	:	73	: :	

130 × 73 × 6 = 56940 for a dividend.

```
Second term, 365
First,       100
             ---
   Divisor, 36500
    36500)56940(156 cents.
          36500
          -----
          204400*
          182500
          ------
          .219000*
           219000
           ------
           ......
```

* Decimals annexed.

CONTRACTED PROPORTION,

OR,

CONTRACTIONS IN THE RULE OF THREE.

RULE 1.

Divide the second term by the first, and multiply that quotient by the third.

EXAMPLE.

If 3 yards of cloth cost £3 18s. 6d. what will 12 yards cost? Answer, £15 14s.

Yds. £. s. d. Yds.
÷ 3 ; 3 18 6 : : 12
1 6 2 quotient.
12

£15 14 0 answer.

RULE 2.

Divide the first term by the third, and divide the second by that quotient.

EXAMPLE.

Bought 4 parcels of indigo, each 3 pounds, for 39 dol. or, 3900 cents; how much did 5 pounds cost?

4 parcels × 3 = 12lb. Answer, 16 dols. 25 cents.

lb. cents. lb.
12 : 3900 : : 5
5)12
2.4)3900(1625 cents, or
24 [16 dol. 25 cts.

150 continued.

150 continued.
144

60
48

120*
120

RULE. 3.

Divide the third term by the first, and multiply that quotient by the second.

EXAMPLE.

Bought 5 bushels of salt for £ 2 2*s.* 1*d.* what will 25 bushels cost at that rate? Answer, £ 10 10*s.* 5*d.*

bu. £. *s.* *d.* bush.
5 : 2 2 1 : : 25 5)25
Quotient & multiplier, 5

£ 2 2 1 second term.
5 quotient.

10 10 5 Answer.

RULE 4.

Divide the first term by the second, and divide the third by that quotient.

EXAMPLE.

If I give 7 dol. and 50 cents for 30 lb. sugar, what must be paid for ½ a hundred or 56 lb.? Ans. 14 dollars.

---

* A decimal added to balance the decimal in the divisor.

lb. dol. lb.
30 ; 7.50 : : 56
7.50)30.00(4 quotient. 4)56
3000 14 dollars.

....

RULE 5.

Divide the first term by the third, and multiply the second by that quotient.

EXAMPLE.

If I have 36 cwt. carried 50 miles for 18 dollars, how far may I have 12 cwt. carried for the same money?
Answer, 150 miles.

cwt. m. cwt.
36 : 50 : : 12 Inverse proportion.
12)36 50 second term.
3 3 quotient.
150 miles.

RATE-BILL.

Suppose a school to consist of 32 pupils, subscribed for by the proprietors; that a Master teaches during the term of one quarter, or 71.5 days, at 17 dollars and 16 cents a month, and his wages amount to 51 dollars 48 cents; that the whole number of days which each scholar has attended, being added together, make 2288; and that A, has sent 214.5 days, B, 71.5, C, 143, &c. how shall we know what each man has to pay, without making a statement in the Rule of Three for each one's quota?

RULE.

1. As the whole number of days,
is to the whole sum;
So is one day,
to a common multiplier.

2. Multiply each man's number of days by this common multiplier, the product will be the quota sought.

EXAMPLE.

days. cents. day.
2288 : 5148.00 : : 1

2288)5148.00(2.25 cents for [one day.
4576
. 5720
4576
11440
11440
. . . . .

A, sent 214.5 days.
Multiplier, 2.25
10725
4290
4290
Quota, 482.625

B, sent 71.5 days.
Multiplier, 2.25
3575
1430
1430
160.875 quota.

C, sent 143 days.
Multiplier, 2.25
715
286
286
321.75 quota.

Names.	days.	$.	cts.	decimals
A,	214.5	4	82	.625
B,	71.5	1	60	.875
C,	143.	3	21	.750

When the first decimal figure happens over five, add one cent. For instance, make A's quota 83, B's 61, and C's 22, rejecting the fractions.

INTEREST.

Interest is a sum of money allowed by the borrower to the lender. For instance, A, borrows 400 dollars of B, for one year, and agrees to pay B, 7 dollars for the use of every hundred dollars. This is called 7 per cent.; 7 dollars being the rate per cent.*

In this case the sum 400 dollars is called the *principal*; 28 dollars the *interest*, and the interest added to the principal, makes 428 dollars, which sum is called the *amount*.

LESSON I.

If 100 dollars in 1 year will give 7 dollars interest, what will 400 dollars give in five years. Ans. 140 dolls.

---

[*] *Rate per cent.*, signifies, a price fixed by the hundred.
Rate per cent. per annum, signifies, a price fixed by the hundred by the year.

Although interest is calculated by the Rule of Three, yet there is a short and easy way without a formal statement.

RULE.

Multiply the principal by the rate per cent. and divide that product by 100, the quotient will be the interest for one year.

Then, multiply the interest of one year by the time, the product will be the answer.

EXAMPLE.

400 dollars principal.
7 per cent.
Interest, 28|00 This number 2800 is divided by 100.
Time, 5 Years.
140 dollars interest in 5 years.

LESSON 2.

What is the amount of a note of hand for 14 dollars 37½ cents on interest 2 years, at 7 per cent. per annum?

Answer, $16 38.75 cents.

Reduce the given sum or principal to cents.

14 dolls. 37½ cents = 1437.5 cents.

1437.5 cents.
7 per cent.
10062.5
2 years.
201|25.0 divided by 100.

Here the interest for two years appears to be 201 cents and .25 hundredths of a cent; which sum added to the principal, makes 1638.75 cents, or, 16 dollars 38 cents and .75 hundredths of a cent.

Statement, 1437.5 cents, principal.
201.25 interest.
1638.75 amount.

LESSON 3. *See Card* 32.

What is the interest of £ 13 17*s.* 6*d.* for 1 year at 6 per cent.?

Ans. £ 0 16*s.* 7*d.* 3*qrs.* and 20 hundredths of a farthing.

£13 17 6 principal.
6 rate per cent.

83 5 0
20

s. 16|65
12

d. 7|80
4

q. 3|20

N. B. Cutting off two figures to the right hand, divides by 100.

LESSON 4.

What is the Interest of 155 dollars for 1 year, at 2½ per cent. ?
Ans. 387 cents $\frac{50}{100}$ of a cent.

155 dol.=15500 cents principal.
2

31000 product.
7750 half the principal.

387|50 divided by 100.

In this case annex two ciphers to the dollars, to reduce them into cents, then multiply by 2 and add half the principal to that product.

LESSON 5.

What is the interest of 231 dollars for 1 year at 3¼ per cent. ? Ans. 750 cents $\frac{75}{100}$ of a cent.

Multiply the principal by 3 and add ¼ of the principal to that product.

23100 cents principal.
3

69300 product.
5775 a fourth of the principal.

Total, 750|75 divided by 100.

Another way by Decimals.—See Card 32.

One fourth equals .25; therefore, multiply by 3.25 for the rate per cent. ?

23100 cents principal.
3.25 or 3¼ rate per cent.

1155
462
693

750|75.00 divide by 100 after pointing off the [decimals

LESSON 6.

What is the interest of £8 16 10 for 1½ year, at 7 per cent.? Answer, £0 18*s.* 6*d.* 3*q.*

£8 16 10 prin.
7 rate per cent.

61 17 10
20

s. 12|37
12

d. 4|54
4

q. 2|16

s.	*d.*	*q.*	
12	4	2	one year's intr.
6	2	1	half a year's intr.
18	6	3	one and a half year.

LESSON 7.

What is the interest of 700 dollars for 3 years and ¾, at 7 per cent. per annum? Answer, 18375 cents.

70000 cents principal.
7 rate per cent.

4900|00 divided by 100.
4900 cents interest for one year.
3 number of years.

14700 for 3 years.
2450 for ½ year.
1225 for ¼ of a year.

18375 cents interest for 3¾ years.

LESSON 8.

What is the interest of 35 dol. 37½ cents for 1 year, at 5 per cent.? Answer, 176.875 cents.

When the rate per cent. is five, divide the principal by 20; the quotient will be the interest for 1 year: this can be easily scanned, because 5 times 20 make 100, and we can have 5 times 20 in 100.

35 dol. 37½ cents = 3537.5 cents.

÷ by 5 and by 4 will be the same as 20.	5)3537.500 principal. 4)707.500 176.875 answer in cents.

LESSON 8.

Wrought out in full.

3537.5 cents principal.
5 rate per cent.

100)17687.5(176.875 cents
100 [for answer.
.768
700
.687
600
.875
800
.750*
700
.500*
500
. . .

ANOTHER WAY.

cts. prin.
20)3537.500(176.875
20
153
140
.137
120
.175
160
.150
140
.100
100
. . .

By this 5 per cent. we can prove any sum of interest of any rate per cent.; for instance, if the rate per cent. be 6, first take one twentieth part of the principal, which quotient will be the interest for one year at 5 per cent.; then one fifth of that interest added, will make a sum equal to one arising from 6 per cent.; and two-fifths added will make a sum equal to one of 7 per cent., &c. Again, subtract one fifth and we have a sum equal to one of 4 per cent.; subtract two fifths, we have a sum of 3 per cent., &c. &c.

This is an easier way to prove sums in interest, than by the Rule of Three.

FOR EXAMPLE SEE

LESSON 9.

What is the interest of 250 dollars for 1 year, at 7 per cent? Answer, 1750 cents.

---

* Decimals annexed.

250 dol. = 25000 cents.

Principal.	÷ 20)25000 principal.
25000	5)1250 In. for 1 yr. at 5 pr. ct.
7	250 } two fifths added.
	250 }
1750|00 Answer.	Proof, 1750 cents.

LESSON 10.

What is the interest of £165 8s. 4d. for 4 years, at 6 per cent. per annum? Answer, £39 14s.

£165 8 4 principal.

£ s. d.	£ s. d.
20)165 8 4	8 5 5 quotient.
160	
..5	£8 5 5 from 5 per cent.
20	1 13 1 one 5th.
108	9 18 6 by 6 per cent.
100	4 number of years.
..8	£39 14 0 Answer.
12	
100	

LESSON 11.

What is the amount of £35 15 10 for 3 years, at 6 per cent. per annum? Answer, £42 4s. 8d. 0.$\frac{8}{10}$q.

£35 15s. 10d.
6

£ 2|14 15 0	£2 2 11 1.6q. for 1 year.
20	3 No. of years.
s. 2|95	Interest, 6 8 10 0.8 for 3 years.
12	35 15 10 principal.
d. 11|40	£42 4 8 0.8 amount.
4	
q. 1|60	
10	
.6|00	

PROOF OF LESSON 11.

£.	s.	d.	£.	s.	d.	q.	
20)35	15	10(1	15	9	2		quotient.

20
15
20
20)315
20
115
100
.15
12
20)190
180
10
4
20)40

£1	15	9	2	at 5 per cent.
	7	1	3.6	one fifth.
2	2	11	1.6	at 6 per cent.
			3	No. of years.
6	8	10	0.8	interest.
35	15	10		principal.
42	4	8	0.8	amount.

By multiplying the remainder after the farthings, by 10, we find the decimal of a farthing. In the above there remained 3; 3 times 10 is 30; 5 in 30? 6 times; this gives .6 of a farthing.

BROKAGE,

Is an allowance of a certain number of shillings and pence on every hundred pounds, or of a certain number of cents on every hundred dollars.

LESSON 12.

Suppose my friend sells goods for me to the amount of £415 16*s.* 8*d.* what will his brokage be at the rate of 5*s.* on a hundred pounds? Answer, £1 0*s.* 9*d.* 2*q.*

RULE.

As £100,
is to the rate per cent.;
So is the principal,
to the brokage required.

Reduce the shillings and pence to the decimals of a pound, and annex them to the pounds for a third term. Look at your Rule in Decimals.

12| *d.* 8.000
20| *s.* 16.667(.83335
160
. 66
60
. 67
60
. 70*
60
100*

£. *s.* £.
100 : 5 :: 415.83335
5
s. 20| 79.16675
12
d. 9| 5000100
4
q. 2| 00004

Proof of Lesson 12.

RULE.

Divide the principal by 100; then divide that quotient by the aliquot parts of a pound arising from the rate per cent.

Illustration.

5*s.* = one fourth of a pound; 4*s.* = one fifth of a pound; 6*s.* = one fifth of a pound and one fifth of that fifth; 6*s.* 8*d.* = one third of a pound; 2*s.* 6*d.* = one eighth of a pound, &c.

EXAMPLE.

£ 4|15 16 8
|20
s. 3|16
|12
d. 2|00

	£.	*s.*	*d.*	*q.*	
5*s.* = $\frac{1}{4}$ of a pound.	4)4	3	2	0	the quotient.
	1	0	9	2	proof.

LESSON 13.

What is the brokage of 350 dollars at the rate of 60 cents on 100 dollars? Answer, 210 cents.

$ cts. $
100 : 60 :: 350
60
210|00

The answer will be in cents when the second term is cents.

LESSON 14.

What is the brokage of 455.25 dollars, at the rate of 70 cents on a hundred dollars?

Answer, 318 cents .675 of a cent.

$ cts. $
100 : 70 :: 455.25
70

100)31867.50(318.675 cents.
300
.186
100
.867
800
.675
600
.750
700
.500*
500

Shorter way.
455.25
70
318|67.50

INTEREST FOR DAYS.

RULE.

" As 365 days are to the interest of the given sum for one year;
So is the time proposed, to the interest required."

LESSON 15.

What is the interest of 5075 cents for 90 days, at 7 per cent. per annum?

Answer, 87.59 cents.

5075 principal.
7 rate per cent.
355|25
355.25 cts. interest for 1 year.

days. cts. days.
365 : 355.25 :: 90
90
365)31972.50(87.59
2920
.2772

[*Continued.*

2772
2555
.2175
1825
.3500
3285
.215+

RULE FOR PROOF.

Multiply the principal in cents by the rate per cent., and that product by the number of days for a dividend. Multiply 365 by 100 for a divisor; the quotient will be the answer in cents.

5075 principal.
7 rate per cent.
35525 365×100=36500 divisor.
90 days.
3197250 dividend.

36500)3197250(87.59 proof.
292000
.277250
255500
.217500*
182500
.350000*
328500
.21500+

An easier method of finding the interest for days or months in the course of ordinary business.

Suppose 1 month or 30 days to be $\frac{1}{12}$ part of a year, and that 1 day is $\frac{1}{30}$ of a month; then from the following table we can take any part of a year at an instant.

1 day equals	$\frac{1}{30}$ of a month.	6 months equal	$\frac{1}{2}$ of a year.
2	$\frac{1}{15}$	4	$\frac{1}{3}$
3	$\frac{1}{10}$	3	$\frac{1}{4}$
5	$\frac{1}{6}$	2	$\frac{1}{6}$
6	$\frac{1}{5}$	1½	$\frac{1}{8}$
8	$\frac{1}{4}$	1	$\frac{1}{12}$
10	$\frac{1}{3}$		
15	$\frac{1}{2}$		

LESSON 16.

What is the interest of a note given on the first day of January, 1815, for 34 dollars and 50 cents, payable on the 6th of February, 1816, with interest at 7 per cent. per annum? Answer, 266.32 cents.

3450 cents principal.
7 rate per cent.

241|50 interest of 1 year.

		cents.
30 days $\frac{1}{12}$	12	241.50
6 days $\frac{1}{5}$ of $\frac{1}{12}$	5	20.125
1 day $\frac{1}{6}$ of $\frac{1}{5}$	6	4.025
		0.670+
Answer,		266.320

241 cents and $\frac{50}{100}$ of a cent is the interest for 1 year.

Then January, 1816, has 31 days, and in February we take 6 days, which make 37 days over a year. Then say, 30 days are $\frac{1}{12}$ of a year, 6 days $\frac{1}{5}$ of 30, and 1 day $\frac{1}{6}$ of 6 days.

In small business this method will be sufficiently exact, but in large sums it is advisable to calculate by the preceding rules, because 30 days fall short of $\frac{1}{12}$ of a year.

COMPOUND INTEREST.

Find the interest of the given sum for 1 year, add that interest to the principal and call it the amount. Take this amount for the principal of the second year: Find the amount for the second year and make it the principal of the third year, &c. &c.

NOTE.—Subtract the given sum from the last amount, the remainder will be compound interest.

LESSON 17.

What is the compound interest of 500 dollars for 4 years, at 7 per cent. per annum? Ans. 155 dol. 39 cents.

Principal for the first year, 50000 cents.
Rate per cent. 7

3500|00

Interest for the first year, 3500
Principal, 50000

Amount of the first year, 53500 [*Continued.*

Principal for the second year, 53500
7

Interest for the second year, 3745 3745|00
Principal, 53500

Amount for the second year, 57245
Principal for the third year, 57245
7

Interest for third year, 4007.15 4007|15
Principal, 57245.

Amount for the third year, 61252.15
Principal for the fourth year, 61252.15
7

Interest for the fourth year, 4287.6505 4287|65.05
Principal, 61252.15

Fourth year's amount, 65539.8005
Given sum, 50000.

Answer in cents, 15539.8005, that is to say, 155 dollars, 39 cents, 8 tenths and 5 ten thousandths of a cent.

DECIMAL INTEREST.

Make a common multiplier for the rate per cent. thus: If 100 cents in 1 year give 7 cents interest, what will 1 cent give in the same time? 100 : 7 : : 1
Principal, 1 cent.

100)7.00
.07

Here appears to be 7 hundredths of a cent for the interest of 1 cent 1 year: This .07 we will call a common multiplier, by which any number of cents may be multiplied, and the product will be their interest at 7 per cent. for 1 year.

For 6 per cent. .06 will be a common multiplier.

For 5 per cent., .05; for 5½, .055, &c. They are all found by the rule of proportion as before.*

LESSON 18.

What is the interest of 354 cents for 1 year, at 7 per cent.? Ans. 24.78 cents.

Principal, 354 cents.
Com. mul. ·07

24.78

LESSON 19.

What is the interest of 13 dollars 37½ cents for 1 year, at 6 per cent.?

Answer, 80.25 cents.

Principal, 1337.5 cents.
Com. multiplier, .06

80.250 cents.

In the last lesson we point off three decimals in the product, because there are 3 in the factors, that is, one in the multiplicand, and two in the multiplier.

LESSON 20.

What is the interest of 316 dollars and 50 cents for 4 years at 3½ per cent. per annum? Ans. 44 dol. 31 cents.

Principal, 31650 cents.
Com. multiplier, .035

158250
94950

one year's int. 1107.750
Number of yrs. 4

Ans. 4431.000 cents.

LESSON 21.

My agent has bought cattle to the amount of 3452 dollars and 87½ cents; how much will his commission be at the rate of two and a half per cent?

Answer, 86 dol. 32 cents.

Principal, 345287.5 cents.
Com. multiplier, .025

17264375
6905750

Ans. 8632.1875 cents.

LESSON 22.

What is the interest of £32 1*s.* 6*d.* for 5 years at 6½ per cent. per annum? Ans. £ 10 8*s.* 5*d.* 3*q.* 4 *tenths.*

A common multiplier is found in this case by the same proportion as that above Lesson 18, viz.

If 100 pounds in a year will give 6.5 pounds interest, what will one pound give in the same time?

Ans. .065 of a pound.

---

* This common multiplier can be on a memorandum, or retained in memory.

100 : 6.5 : : 1
100)6.500(.065
600
———
.500
500

Reduce the shillings and pence to the decimal of a pound, as at D.

Principal, £ 32.075
Com. mul. .065
———
160375
192450
———
£2 | .084875
20
———
s. 1 | .697500
12
———
d. 8 | .370000
4
———
q. 1 | .480000

12d. | 6.000
20s. | 1.500(.075 D
140
———
.100
100

	£.	s.	d.	q.
Int. for 1 yr.	2	1	8	1.48
Number of yrs.				5
Ans.	10	8	5	3.40

Proof for Lesson 22.

	£		
Principal,	32	1	6
Rate per cent. 6½			6
	192	9	0
Half the principal,	16	0	9
	£ 2 | 08	9	9

20
———
s. 1 | 69
12
———
d. 8 | 37
4
———
q. 1 | .48 of a farthing.

	£			
Interest for 1 year,	2	1	8	1.48
Number of years,				5
Proof,	10	8	5	3.40

PROBLEMS OF INTEREST.

To find the principal when the rate per cent., the time, and the amount are given, say,

" As the amount of £ 100 at the rate and time given,
is to £ 100;
So is the amount given,
to the principal required."

LESSON 23.

What principal being put to interest for 5 years, at 6 per cent. per annum, will amount to 390 dollars?

Answer, 300 dollars.

If 100 dollars will give 6 dollars interest in one year, then in 5 years the interest will be 30 dollars; add this sum of 30 dollars to the principal 100, and the amount will be 130.

Now say: If 130 amount, arise from 100 principal, what will 390 amount, arise from?

```
A.    P.     A.
130 : 100 : : 390
      130)39000(300 dollars.
          390
          ———
          ...00
```

To find the rate per cent., when the principal, the time, and the amount are given, say:

" As the principal,
is to the interest for the whole time;
So is £ 100,
to its interest for the same time."

" Divide the interest last found by the time, and the quotient will be the rate per cent."

LESSON 24.

At what rate of interest per cent. will 300 dollars amount to 390 in 5 years? Ans. 6 per cent.

Subtract the principal from the amount, the remainder will be the interest of 300 dollars for the whole time. Then say: If 300 principal in the whole time, give 90 interest, what will 100 give in the same time?

3|00 : 90 : : 100
3)90|00
Time 5 yrs. 5)30(6 quotient or rate per cent.

To find the time when the principal, the rate per cent. and the amount are given, say,

" As the interest of the principal for 1 year at the given rate,
is to one year;
So is the whole interest,
to the time required."

LESSON 25.

In what time will 300 dollars amount to 390, at 6 per cent. per annum? Answer, 5 years.

One hundred dollars give 6 dollars interest in a year; then 300 dollars will give 18 for interest.

If 18 dollars require one year, what will 90 dollars the whole interest require?

Principal, 300 dol.
Amount, 390
The whole interest, .90

dol. yr. dol.
18 : 1 :: 90
18)90(5
90

REBATE.

Rebate, is an allowance for present payment before a sum of money becomes due.

Present worth, is the sum to be paid immediately for another sum due at a future time.

For instance, the sum of 200 dollars, at 7 per cent., will be due 12 months hence; what is the present worth? We can perceive that $200 will gain 14 at 7 per cent. interest, and can be taken from the debt; but this is too great a deduction: What sum at 7 per cent. interest will amount to

200 dollars in 12 months? Such a sum is the present worth required.

RULE.

As the amount of 100 dollars, at the rate and time given,
is to 100 dollars;
So is the whole debt,
to the present worth required.

LESSON 1.

What is the present worth of 200 dollars for one year at 7 per cent. rebate?

Answer, 186 dol. 91 cents.

```
100 dollars +
  7 dollars interest for 1 yr.
---
107 amount for 1 year.
200 dollars the whole debt.
```

```
                    A.      P.       A.
As the sum of 107  :  100  : :  200 to its principal.
```

Read thus, As the sum of 107 dollars amount, is to 100 dollars principal; so is the sum of 200 dollars amount to its principal, or to the present worth.

```
                 dol.
                 100  2d. term.
                 200  3d. term.
                 ---
1st. term, 107)20000(186.91
                107  [present
                ---  [worth.
                . 930
                  856
                  ---
                 . 740
                   642
                   ---
                  . 980*
                    963
                    ---
                   . 170*
                     107
                     ---
```

Remainder . 63 to be added in the proof.

Thus we find that the sum 186 dol. 91 cents is the present worth required. Subtract the present worth from the whole debt, the remainder will be the rebate; viz. 13 dol. .09 cents.

Rule for proof.

Find the amount of the present worth for the time and at the rate per cent. given.

EXAMPLE.

What is the amount of 18691 cents for 1 year, at 7 per cent. interest?

```
18691 principal and 63 rem.
    7 rate per cent.
-----
1309|00 interest for 1 year.
18691   principal.
-------
20000 cts. amount; or $200
```

LESSON 2.

What is the present worth of 450 dollars payable 9 months hence at 6¼ per cent. per annum?

Answer, 429 dols. 8 cents, 2 tenths of a cent and 25250 tenths of cents remain.

Reduce the three terms into tenths of cents that we may more readily comprehend the true value of the decimals.

100 dollars = 100000 tenths [of cents.

```
100000
    6¼ per cent.
------
600000 product by 6.
```

```
600000 product by 6.
 50000 half the principal.
------
6500|00 interest 1 year.
----
3250|  ½ a year.
1625|  ¼ of a year.
----
  4875 int. of 100 dols. 9 mo.
100000 principal.
------
104875 tenth of cents for
the amount of 9 months.
```

```
     10ths. A.        10ths. P.        10ths. A.
As 104875     :      100000    : :    450000 to P.W.
            104875)45000000000(429082 P.W.
                   419500
                   ------
                   .305000
                    209750
                    ------
                    .952500
                     943875
                     ------
                     ..862500
                       839000
                       ------
                       .235000
                        209750
                        ------
      First remainder,  .25250  tenths of cents.
```

We find that 429082 tenths of cents marked, P W, to be the present worth of 450 dollars. The amount of this present worth at 6¼ per cent. 9 months, will prove the work true.

Proof for Lesson 2.

```
 429082 tenths of cents principal.
      6¼ per cent. interest.
-------
2574492 product by 6.
 214541 half the principal.
-------
27890|33 interest for 1 year.
```

[*Continued.*

27890|33 interest for 1 year.

13945|165 for half a year.
6972|5825 for one fourth of a year.

20917|7475 for 9 months.
429082| principal.
|25250 first remainder.

450|00.0|00000 amount or proof.

Subtract the present worth from the given sum, the remainder will be the rebate.

EXAMPLE.

450000 given sum or debt.
429082 25250 present worth and remainder.

20|91.7 74750
$20 91c. 7 tenths the rebate.

BARTER.

Barter is an exchanging of one commodity for another.

LESSON 1.

How many yards of gingham, at 37.5 cents a yard, must be given for 90 pounds of beef, at 5 cents a pound?

Answer, 12 yards.

90lb. at 5 cents.
5

450 cents, amount of the beef.

Now say, if 37.5 cents will buy one yard, how many yards will 450 cents purchase?

37.5 : 1 :: 450.0
37.5)450.0(12 yards, answer.
375

.750
750

Proof: What cost 12 yards at 37.5 cents?
12

Answer or proof, 450.0 cents.

LESSON 2.

A farmer exchanged 25 bushels of potatoes, at 50 cents a bushel, for sugar at 20 cents a pound; how many pounds were required? Answer, 62lb. 8 oz.

25 bushels.
50 cents a bushel.
———
1250

cents. lb cents.
20 : 1 : : 1250
20)1250(62lb.
120
———
..50
40
———
10
16 oz. in a pound, 16
———
20)160(8 oz.
160

LESSON 3.

A forgeman delivered 5 cwt. 3 qrs. of iron, at 8 dollars 96 cents a hundred, for which he received 40 yards of coating; how much did the cloth cost a yard?

Answer, $ 1 28.8 cts.

112lb. = 896 cents.
5
———
5 hundred, 4480
½ a hundred, 448
¼ of a hundred, 224
———
5¾ hundred, 5152 cents.

yds. cts. yd.
40 : 5152 : : 1
40)5152(128.8
40
———
115
80
———
.352
320
———
.320*
320

LOSS AND GAIN.

LESSON 1.

Bought 64 bushels of salt, at 87½ cents a bushel, and sold the same at 1 dollar and 5 cents a bushel; what sum did I gain? Answer, $ 11 20c.

105 cents a bushel.
64
420
630
6720

87.5 cents a bushel.
64 bushels.
3500
5250
5600.0 prime cost,
6720 sales.
1120 cents gain.

LESSON 2.

Bought 348 yards of cloth for 174 dollars; how must it be sold a yard to gain 25 per cent.? Ans. at 62½ cents.

Note. ¼ of any sum added to itself, will make 25 per cent.

yds. cts. yd.
348 : 17400 : : 1
348)17400(50 cents a yard, prime cost.
1740
. 0

4)50
12.5
62.5 cents.

LESSON 3.

Bought 11 cwt. 2 qrs. 21 lb. tobacco, at 560 cents a hundred; but, it being damaged, I sold it at 4 per cent. loss; how much was that a pound? Ans. 4.8 cents.

2) 560 cents, price of 1 hundred.
11
6160 price of 11 hundred.
4) 280 of ½ a hundred, or 56 lb.
2) 70 of ⅛ of a hundred, or 14 lb.
35 of $\frac{1}{16}$ of a hundred, or 7 lb.
6545 of the whole.
4 per cent.
261|80 to be deducted

6545 price of the whole.
261.80 deduction.

6283.20 for the sales.

11 cwt. 2 qrs. 21 lb.
4

46 qrs.
28

369
94

1309 lbs. in all.

lb. cts. lb.
1309 : 6283.20 :: 1
1309)6283.20(4.80 cts. ans.
5236

10472
10472

.....0

SINGLE FELLOWSHIP, OR, FELLOWSHIP WITHOUT TIME.

Two or more partners stock money together and trade a certain time, then divide the gain into shares according to each one's stock: this method of transacting business is called Fellowship.

EXAMPLE.

LESSON 1.

Two merchants, A and B, join in partnership; A, lays in 80 dollars, B, 120, and they gain 50 dollars; what is each man's share of said gain?

Answer, A, must have 20, and B, 30 dollars.

RULE.

As the sum of the several stocks,
is to the gain or loss;
So is each person's share in stock,
to his share of gain or loss.

A, 80 dollars.
B, 120

200 sum of the stocks.
200 : 50 :: 120
50

200)6000(30 B.
6000

S. G. A.
200 : 50 :: 80
50

200)4000(20 A.
400

...0

LESSON 2.

A bankrupt is indebted to C, 50 dollars, to D, 130 dollars, to E, 320, and his whole estate amounts to 275 dollars only; how must it be divided among the creditors?

Ans. C, must have 27 dols. 50 cts. D, 71 dols. 50 cts. and E, 176 dols.

C's stock or debt,	50 dols.
D's	130
E's	320
Amount of dts.	500
Estate,	275
Loss,	225

```
 S.    loss.     C.
500 : 225 : : 50
               50
     ------
500)11250(22.5 C's loss.
    1000
    ----
    .1250
     1000
     ----
    .2500*
     2500
```

```
 S.    loss.     D.
500 : 225 : : 130
      130
     -----
      675
     225
     -----
500)29250(58.5 D's loss.
    2500
    ----
    .4250
     4000
     ----
    .2500*
     2500
```

```
 S.    loss.     E.
500 : 225 : : 320
      320
     -----
      450
     675
     -----
500)72000(144 E's loss.
```

[Continued.

500)72000(144 E's loss.
500
2200
2000
2000
2000
....

PROOF.

Share of C,	27.50
of D,	71.50
of E,	176.
	275.00

275.00 equal to the amount of the whole estate or effects.

C's demand,	50.	
Loss,	22.50	subtract.
Share,	27.50	
D's demand,	130.	
Loss,	58.50	
Share,	71.50	
E's demand,	320	
Loss,	144	
Share,	176	

DOUBLE FELLOWSHIP, OR, FELLOWSHIP WITH TIME.

RULE.

Multiply each man's stock and time together: Then say,
As the sum of those products,
is to the whole gain or loss;
So is each product,
to each man's share of the gain or loss.

LESSON 1.

Two merchants traded together: A, put in 120 dollars for 12 months, and B, 100 for 15 months; they gained 55 dollars; what was each one's share?

Answer, { A, had 26 dols. 93$\frac{2580}{2940}$ cents.
{ B, had 28 dols. 6$\frac{360}{2940}$ cents.

A, 120 for 12 months.
12

1440 A's product.
B, 100 for 15 months.
15

1500 B's product.

1440 A.
1500 B.

2940 sum of the [products.

S. Pro. G. A's Pro.
2940 : 55 : : 1440
55

7200
720

$ cts.
2940)79200(26.93$\frac{2580}{2940}$ [for A.
588

20400
17640

27600*
26460

11400*
8820

2580

S. Pro. G. B's Pro.
2940 : 55 : : 1500
1500

275
55

$ cts.
2940)82500(28.06$\frac{360}{2940}$ for B
5880

23700
23520

.. 18000**
17640

.. 360

PROOF OF LESSON 1.

A's share, 2693 cents and $\frac{2580}{2940}$
B's, 2806 $\frac{360}{2940}$

dol. 55.00 whole gain.

2580
360

2940 } or 1 cent to carry.
2940 }

LESSON 2.

A, B, and C, hired a pasture for the sum of 115 dollars: A, turned in 35 horses 40 days, B, 30 horses 40 days; and C, 24 horses 100 days; what part of the 115 dollars must each man pay? Answer, A, must pay 32.2 dollars, B, 27.6 and C, 55.2.

A, 35 x 40 = 1400
B, 40 x 30 = 1200
C, 100 x 24 = 2400

No. of days, 5000
The whole loss, 115
5000 : 115 : : 1400 A.
1400

460
115

5000)161000(32.2 A.
15000

. 11000 *Continued.*

11000 continued.
10000

.10000*
10000

5000 : 115 : : 1200 B.
1200

5000)138000(27.6 B.
1000

.38000
35000

.30000*
30000

5000 : 115 : : 2400 C.
2400 continued.

2400 continued.

460
230

5000)276000(55.2 C.
25000

.26000
25000

.10000*
10000

$ cts.	
32.20	the share of A.
27.60	of B.
55.20	of C.
115.00	loss, or proof.

END OF PART NINTH.

INTRODUCTION TO ARITHMETIC,

PART X.

CONTAINING,

PRACTICE AND TARE AND TRET.

PRACTICE.

THIS is a short way of finding the value of goods: any question in the Single Rule of Three direct, where the first term is unity or one, may be answered by *Practice.*

The rule is generally performed by taking aliquot parts for a divisor, as, 20 quills at a farthing each; how much do they come to?

We readily know that 20 quills cost 20 farthings, and that if we divide 20 by 4, the quotient will be the answer in pence, viz. 5 pence.

Again, 20 at 2 farthings each. We perceive in a moment that 20 halfpence will make 10 pence; therefore we say two farthings make the half of a penny; divide 20 by 2, the quotient will be the answer in pence.

Twenty at 3 farthings each: here we reflect and find, that the half of 20, and the half of that half, will make the answer; for it must be three times as much as the first quantity at one farthing; therefore say, 2 farthings make the half of a penny, and a farthing is the half of a halfpenny; divide the given number by 2, that quotient by 2, add the two quotients together, and the answer will be 15 pence;

Thus, 20 at 3 farthings:

2	$\frac{1}{2}$	20
1	$\frac{1}{2}$	10
		5
		15*d.*

This is taking aliquot or even parts. *See Card* 32.

In order to learn expeditiously, we must get the following table by heart.

TABLE.

s.	*d.*	*q.*	£	*s.*	*d.*	*Cwt.*	*Tons*	*Of a hundred.*	
$\frac{1}{2}$ =	6		$\frac{1}{2}$ =	10		2 =	$\frac{1}{10}$	1qr. or 28lb. =	$\frac{1}{4}$
$\frac{1}{3}$	4		$\frac{1}{3}$	6	8	2$\frac{1}{2}$	$\frac{1}{8}$	2 or 56	$\frac{1}{2}$
$\frac{1}{4}$	3		$\frac{1}{4}$	5		4	$\frac{1}{5}$	16	$\frac{1}{7}$
$\frac{1}{6}$	2		$\frac{1}{6}$	3	4	5	$\frac{1}{4}$	14	$\frac{1}{8}$
$\frac{1}{8}$	1	2	$\frac{1}{8}$	2	6	10	$\frac{1}{2}$	*Of a qr. of a cwt.*	
$\frac{1}{12}$	1		$\frac{1}{10}$	2				3$\frac{1}{2}$ lb. =	$\frac{1}{8}$
			$\frac{1}{12}$	1	8			4	$\frac{1}{7}$
								7	$\frac{1}{4}$
								14	$\frac{1}{2}$

When reading the above table we say, "Half a shilling equals 6 pence; one third of a shilling equals 4 pence; one fourth of a shilling equals 3 pence," &c. "One half of a pound equals 10 shillings; one third of a pound equals six shillings and eight pence," &c.

"Two hundred weight equal one tenth of a ton; two and a half hundred weight one eighth of a ton," &c.

"One quarter or 28 lbs. equal one fourth of a hundred weight; two quarters or 56 lbs. equal one half of a hundred weight," &c. Then we say, "Three and a half pounds equal one eighth of a quarter of a hundred weight; four pounds equal one seventh," &c.

CASE 1.

When the price is less than a penny.

RULE.

Divide by the aliquot parts that are in a penny, then by 12 and by 20, which will give the answer.

LESSON 1.

Bought 7612 pipes at 1 farthing each; 7612 at 2 farthings, and 4712 at 3 farthings each; what did the parcels come to separately, in pounds, shillings, &c.?

Ans. at 1q. £7 18*s.* 7*d.*, at 2q. £15 17*s.* 2*d.*, and at 3q. £14 14*s.* 6*d.*

1 *q.*	$\frac{1}{4}$ *d.*	7612 at 1*q.*	
	12	1903	
	20	15|8	7*d.*
Ans.	£ 7	18*s.*	7*d.*

2*q.*	$\frac{1}{2}$*d.*	7612 at 2*q.*	
	12	3806	
	2|0	31|7	2*d.*
Ans.	£ 15	17*s.*	2*d.*

4712 at 3*q.* 4712 ÷ 2 = 2356 ÷ 2 = 1178 + 2356 = 3534*d.* or £14 14*s.* 6*d.*

CASE 2.

When the price is less than a shilling.

RULE.

Divide by the aliquot part or parts in a shilling, add the quotients together and divide by 20 as before to ascertain the pounds.

LESSON 2.

1*d.*	$\frac{1}{12}$*s.*	7612 at 1*d.*	
	2|0	63|4	4*d.*
Ans.	£ 31	14	4

LESSON 3. *See Card* 32.

1*d.*	$\frac{1}{12}$*s.*	8612 at 1*d.* 1*q.*	
1*q.*	$\frac{1}{4}$*d.*	717	8
		179	5
	2|0	89|7	1
Ans.	£ 44	17	1

LESSON 4. *See Card* 32.

ONE METHOD.

2*q.*	$\frac{1}{2}$*d.*	4121 at 1*d.* 2*q.*		
		2060	2	
	12	6181	2*q.*	
	2|0	51|5	1*d.*	
Ans.	£ 25	15	1	2

ANOTHER METHOD.

1*d.*	$\frac{1}{12}$*s.*	4121 at 1*d.* 2*q.*		
2*q.*	$\frac{1}{2}$*d.*	343	5	
		171	8	2
	2|0	51|5	1	2
Ans.	£ 25	15	1	2

LESSON 5.

1*d.*	$\frac{1}{12}$*s.*	1861 at 1*d.* 3*q.*		
2*q.*	$\frac{1}{2}$*d.*	155	1	
1*q.*	$\frac{1}{2}$2*q.*	77	6	2
		38	9	1
	2|0	27|1	4	3
Ans.	£ 13	11	4	3

LESSON 6.

2*d.*	$\frac{1}{6}$*s.*	4761 at 2 *d.*	
	2|0	79|3	6*
Ans.	£ 39	13	6

* $\frac{3}{6}$ of a shilling.

LESSON 7. *See Card* 32.

2d. | $\frac{1}{6}$s. | 6181 at 2d. 1q.
1q. | $\frac{1}{8}$ | 1030 2
128 9 1
2|0 | 115|8 11 1
Ans. £ 57 18 11 1

LESSON 8. *See Card* 32.

2d. | $\frac{1}{6}$s. | 1218 at 2d, 2q.
2q. | $\frac{1}{4}$ | 203
50 9
2|0 | 25|3 9
Ans. £ 12 13 9

LESSON 9.

2d. | $\frac{1}{6}$s. | 8012 at 2d. 3q.
2q. | $\frac{1}{4}$ | 1335 4
1q. | $\frac{1}{2}$ | 333 10
166 11
2|0 | 183|6 1
Ans. £ 91 16 1

LESSON 10.

3d. | $\frac{1}{4}$s. | 7612 at 3d.
2|0 | 190|3
Ans. £ 95 3

LESSON 11.

3d. | $\frac{1}{4}$s. | 6128 at 3d. 1q.
1q. | $\frac{1}{12}$ | 1532
127 8
2|0 | 165|9 8
Ans. £ 82 19 8

LESSON 12.

3d. | $\frac{1}{4}$s. | 6180 at 3d. 2q.
2q. | $\frac{1}{6}$ | 1545
257 6
2|0 | 180|2 6
Ans. £ 90 2 6

LESSON 13.

3d. | $\frac{1}{4}$ | 7812 at 3d. 3q.
3q. | $\frac{1}{4}$ | 1953
488 3
2|0 | 244|1 3
Ans. £ 122 1 3

LESSON 14.

3d. | $\frac{1}{4}$s. | 7000 at 4d. 1q.
1d. | $\frac{1}{3}$ | 1750
1q. | $\frac{1}{4}$ | 583 4
145 10
2|0 | 247|9 2
Ans. £ 123 19 2

LESSON 15.

4d. | $\frac{1}{3}$s. | 6001 at 4d. 2q.
2q. | $\frac{1}{8}$ | 2000 4
250 0 2
2|0 | 225|0 4 2
Ans. £ 112 10 4 2

LESSON 16.

4d. | $\frac{1}{3}$s. | 7121 at 4d. 3q.
2q. | $\frac{1}{8}$ | 2373 8
1q. | $\frac{1}{2}$ | 296 8 2
148 4 1
2|0 | 281|8 8 3
Ans. £ 140 18 8 3

LESSON 17.

4*d.*	1/3*s.*	8121 at 5*d.* 1*q.*
1*d.*	1/4	2707
1*q.*	1/4	676 9
		169 2 1
	2|0	355|2 11 1
Ans. £		177 12 11 1

LESSON 18.

4*d.*	1/3*s.*	6128 at 5*d.* 2*q.*
1*d.*	1/4	2042 8
2*q.*	1/2	510 8
		255 4
	2|0	280|8 8
Ans. £		140 8 8

LESSON 19.

4*d.*	1/3*s.*	6100 at 5*d.* 3*q.*
1*d.*	1/4	2033 4
2*q.*	1/2	508 4
1*q.*	1/2	254 2
		127 1
	2|0	292|2 11
Ans. £		146 2 11

LESSON 20.

4*d.*	1/3*s.*	6000 at 6*d.* 3*q.*
2*d.*	1/2	2000
2*q.*	1/4	1000
1*q.*	1/2	250
		125
	2|0	337|5
Ans. £		168 15

LESSON 21.

6*d.*	1/2*s.*	6120 at 7*d.* 3*q.*
1*d.*	1/6	3060
2*q.*	1/2	510
1*q.*	1/2	255
		127 6
	2|0	395|2 6
Ans. £		197 12 6

LESSON 22.

6*d.*	1/2*s.*	6000 at 8*d.* 3*q.*
2*d.*	1/3	3000
2*q.*	1/4	1000
1*q.*	1/2	250
		125
	2|0	437|5
Ans. £		218 15

LESSON 23.

6*d.*	1/2*s.*	5918 at 9*d.* 3*q.*
3*d.*	1/2	2959
3*q.*	1/4	1479 6
		369 10 2
	2|0	480|8 4 2
Ans. £		240 8 4 2

LESSON 24.

6*d.*	1/2*s.*	4680 at 10*d.* 3*q.*
3*d.*	1/2	2340
1*d.*	1/3	1170
2*q.*	1/2	390
1*q.*	1/2	195
		97 6
	2|0	419|2 6
Ans.		209 12 6

LESSON 25.

100 at 11*d.*

12 | 1100
2|0 | 9|1 8
Ans. £ 4 11 8

LESSON 26.

8121 at 10*d.*

12 | 81210
2|0 | 676|7 6
Ans. £ 338 7 6

CASE 3.

When the price is more than a shilling, but less than two.

RULE.

In the first place consider the given *quantity* as so many shillings; then take the part or parts with so much of the given *price* as is more than a shilling, and add the amount of shillings arising from these parts, to the given *quantity*, which will produce the answer in shillings.

LESSON 27.

2*q.* | ½*d.* | 1216 at 12*d.* 2*q.*
12 | 608*d.*
50*s.* 8*d.*+1216*s.*
2|0 | 126|6 8
Ans. £63 6 8

LESSON 28.

2*q.* | ½ | 1216 at 12*d.* 3*q.*
1*q.* | ½ | 608
304
12 | 912*d.*
76*s.*
2|0 | 129|2
Ans. £ 64 12

LESSON 29.

1*d.* | $\frac{1}{12}$*s.* | 6100 at 13*d.* 2*q.*
2*q.* | ½ | 508 4
254 2
2|0 | 686|2 6
Ans. £343 2*s.* 6*d.*

LESSON 30.

2*d.* | ⅙*s.* | 6120 at 14*d.* 2*q.*
2*q.* | ¼ | 1020
255
2|0 | 739|5
Ans. £369 15*s.*

LESSON 31.

3*d.* | ¼*s.* | 7612 at 15*d.* 3*q.*
2*q.* | ⅙ | 1903
1*q.* | ½ | 317 2
158 7
2|0 | 999|0 9
Ans. £499 10*s.* 9*d.*

LESSON 32.

4*d.* | ⅓*s.* | 8100 at 16*d.* 3*q.*
2*q.* | ⅛ | 2700
1*q.* | ½ | 337 6
168 9
2|0 | 1130|6 3
Ans. £565 6*s.* 3*d.*

LESSON 33.

4*d.*	$\frac{1}{3}$*s.*	1230 at 17*d.* 1*q.*
1*d.*	$\frac{1}{4}$	410
1*q.*	$\frac{1}{4}$	102 6
		25 7 2
	2|0	176|8 1 2

Ans. £88 8*s.* 1*d.* 2*q.*

LESSON 34.

6*d.*	$\frac{1}{2}$*s.*	9000 at 19*d.* 1*q.*
1*d.*	$\frac{1}{6}$	4500
1*q.*	$\frac{1}{4}$	750
		187 6
	2|0	1443|7 6

Ans. £721 17*s.* 6*d.*

LESSON 35.

6*d.*	$\frac{1}{2}$*s.*	1000 at 21*d.* 3*q.*
3*d.*	$\frac{1}{2}$	500
2*q.*	$\frac{1}{6}$	250
1*q.*	$\frac{1}{2}$	41 8
		20 10
	2|0	181|2 6

Ans. £90 12*s.* 6*d.*

LESSON 36.

6*d.*	$\frac{1}{2}$*s.*	6760 at 23*d.* 2*q.*
3*d.*	$\frac{1}{2}$	3380
*2*d.*	$\frac{1}{6}$	1690
2*q.*	$\frac{1}{4}$	1126 8
		281 8
	2|0	1323|8 4

Ans. £661 18*s.* 4*d.*

* Divide the given quantity by 6.

CASE 4.

When the price consists of any even number of shillings under 20.

RULE.

Multiply the given quantity by half the price, double the first figure of the product for shillings, and the rest will be pounds.

LESSON 37.

486 at 2*s.*
1

Ans. £48 12*s.*

LESSON 38.

7612 at 4*s.*
2

Ans. £1522 8*s.*

LESSON 39.

7618 at 6*s.*
3

Ans. £2285 8*s.*

LESSON 40.

712 at 18*s.*
9

Ans. £640 16*s.*

CASE 5.

When the price is any odd number of shillings under 20.

RULE.

Multiply the given quantity by the price, the product will be the answer in shillings.

LESSON 41.
121 at 3*s.*
3

2|0)36|3*s.*
Ans. £18 3*s.*

LESSON 42.
860 at 7*s.*
7

2|0)602|0
Ans. £301

LESSON 43.
121 at 11*s.*
11

2|0)133|1
Ans. £66 11*s.*

LESSON 44.
612 at 9*s.*
9

2|0)550|8
Ans. £275 8*s.*

CASE 6.

When the price is an aliquot part of a pound, either in shillings or in shillings and pence.

RULE.

Divide by the aliquot part.

LESSON 45.
5*s.* = $\frac{1}{4}$ £ | 471 at 5*s.*
Ans. £117 15*s.**

LESSON 46.
6*s.* 8*d.* = $\frac{1}{3}$ £ | 12 at 6*s.* 8*d.*
Ans. £4

LESSON 47.
3*s.* 4*d.* = $\frac{1}{6}$ £ | 69 at 3*s.* 4*d.*
Ans. £11 10*s.*

LESSON 48.
2*s.* 6*d.* = $\frac{1}{8}$ £ | 21 at 2*s.* 6*d.*
Ans. £2 12*s.* 6*d.*

* $\frac{3}{4}$ of a pound = 15*s.*

CASE 7.

When the price is composed of shillings and pence that are not an aliquot part of a pound.

RULE.

Multiply the given quantity by the shillings, take parts for the pence as in Case 3d, add the quotients to the product, and their amount will be the answer in shillings.

LESSON 49.
3*d.* | $\frac{1}{4}$*s.* | 126 at 9*s.* 3*d.*
9

1134
31 6

2|0 | 116|5 6
Ans. £58 5*s.* 6*d.*

LESSON 50.
4*d.* | $\frac{1}{3}$*s.* | 10 at 12*s.* 4*d.*
12

120
3 4*d.*

2|0 | 12|3 4
Ans. £6 3*s.* 4*d.*

CASE 8.

When the price is pounds only.

RULE.

Multiply the given quantity by the price.

LESSON 51.

72 at £5
5

Ans. £ 360

LESSON 52.

46 at £7
7

Ans. £ 322

CASE 9.

When the price is pounds and shillings.

RULE.

Multiply the given quantity by the pounds; then proceed with the shillings, as in Case 4, when they are even; but if they are odd, work according to Case 5.

LESSON 53.

48 at £7 10*s*.
7

336
24 0 prod. by 5.

Ans. £ 360 0

LESSON 54.

16 at £3 6*s*.
3

48
4 16 prod. by 3.

Ans. £ 52 16*s*.

LESSON 55.

49 at £3 7*s*.
7*s*.

2|0)34|3*s*.

17 3*s*.
147 prod. of £3

Ans. £ 164 3*s*.

LESSON 56.

36 at £5 13*s*.
13*s*.

2|0)46|8

23 8
180 prod. of £5

Ans. £203 8*s*.

CASE 10.

When the price is pounds, shillings, and pence, and the shillings and pence are an aliquot part of a pound.

RULE.

Multiply the given quantity by the pounds, take parts for the shillings and pence, as in Case 6, add them together, and the amount will be the answer.

LESSON 57.

3*s*. 4*d*. | $\frac{1}{6}$ | 47 at £3 3*s*. 4*d*.
3

141
7 16 8

Ans. £148 16 8

LESSON 58.

6*s*. 8*d*. | $\frac{1}{3}$ | 17 at £2 6*s*. 8*d*.
2

34
5 13 4

Ans. £ 39 13 4

CASE 11.

When the price is pounds, shillings, pence and farthings, and the shillings and pence are not an aliquot part of a pound.

RULE.

Reduce the pounds and shillings into shillings; multiply the quantity by the shillings, and take parts for the pence and farthings, as in Case 2; or, work by Compound Multiplication.

LESSON 59.

3*d*. | $\frac{1}{4}$ | 120 at £4 7*s*. 3*d* 2*q*.
87 20

840 87*s*.
960
2*q*. | $\frac{1}{6}$ | 30
5

2\|0 | 10471\|5
Ans. £523 15*s*.

LESSON 60.

6*d*. | $\frac{1}{2}$*s*. | 70 at £1 14*s*. 7*d*.
34 20

280 34*s*.
210
1*d*. | $\frac{1}{6}$ | 35
5 10*d*.

2\|0 | 2421\|0
Ans. £ 121 0 10*d*.

LESSON 61.

21 at £5 14*s*. 7*d*. 1*q*.
3

17 3 9 3
7

Ans. £ 120 6 8 1

LESSON 62.

14 at £2 10*s*. 6*d*.
2

5 1 0
7

Ans. £ 35 7 0

CASE 12.

When the price and quantity are of several denominations.

RULE.

Multiply the price of one by the whole numbers of the quantity, and take parts for the rest of the said quantity.

LESSON 63.

5 cwt. 3qrs. 14lb. sugar at £1 2*s.* 6*d.* a hundred.

56lb.	½ of cwt.	£1 2 6 1 cwt.
		5 cwt.
		5 12 6
28lb.	½ of 56	11 3
14lb.	½ of 28	5 7 2
		2 9 3
		Ans. £6 12 2 1

LESSON 64.

12 cwt. 2qrs. 14lb. at £3 14 0

56lb.	½ cwt.	£3 14 0
		12
		44 8 0
14lb.	¼ of 56	1 17 0
		0 9 3
		Ans. £46 14 3

TARE AND TRET.

In this Rule we must observe six things, viz. The Gross weight, the Tare, the Tret, the Suttle, the Cloff, and the Neat* weig[illegible]

EXPLANATION.

1. The Gross weight is the whole weight of the goods with the hogshead, the barrel, the box, the chest, &c. or whatever contains the merchandise, all being weighed together.

2. Tare is an allowance made to the purchaser for the weight of the hogshead, barrel, box, &c.

3. Tret is an abatement of 4lb. on 104, being the 26th part, allowed for dust, waste, &c.

4. Suttle is the name of the weight after part of the allowances are deducted from the gross.

5. Cloff is an allowance to the purchaser, of 2lb on every 3 cwt.

6. Neat weight is what remains after all allowances are deducted from the Gross.

---

* *Net* or *Nett*, has been obsolete more than forty years.

CASE 1.

When the tare is so much in the whole.

RULE.

Subtract the tare from the gross the remainder is neat.

LESSON 1.

What is the neat weight of 16 hogsheads of tobacco each weighing 5cwt. 1qr. 19lb. gross; tare in the whole, 1600lb.

Answer, 72cwt. 1qr. 20lb.

DIRECTIONS.

Multiply 5cwt. 1qr. 19lb. by 16, or by 4 and by 4; the product will be the whole gross. Reduce 1600lb. tare into hundreds, quarters and pounds; subtract this from the gross, the remainder will be neat.

cwt.	qr.	lb.	
5	1	19	
		4	
21	2	20	
		4	
86	2	24	gross.
14	1	4	tare
72	1	20	neat.

```
      lb.
28)1600(57qr. 4lb.
   140           or
   ---           14 cwt.
    200          [illegible] qr.
    196          [illegible] lb. tare.
    ---
      4
```

CASE 2.

When the Tare is at so much per box, barrel, bag, &c.

RULE.

Multiply the Tare of one barrel by the number of barrels, &c., subtract the product from the gross, the remainder will be neat.

LESSON 2.

In 14 hogsheads of sugar, weighing in the whole 89 cwt. 3 qrs. 17 lbs. gross; tare 100 lbs. on each hogshead, how much neat weight?

Ans. 77 cwt. 1 qr. 17 lbs.

```
lb.
28)1400(50 qrs. or 12 cwt. 2 qrs. tare.
   140            cwt. qrs. lb.
   ———             89   3   17 gross.
   ...0            12   2   00 tare.
                  ————————————
                   77   1   17 Answer.
```

CASE 3.

When Tare is at so much per cent.

RULE.

Divide the gross by the aliquot parts of a hundred weight, subtract the quotient from the gross, and the remainder will be neat [illegible] not an aliquot part, then [illegible]

[illegible] cent.;

[illegible] of pounds gross,

[illegible] required.

LESSON 3.

[illegible] neat weight of 12 casks of rice, each 7 cwt. [illegible] lb. per cent.?

Ans. 75 cwt. 1 qr. 26 lb. 14 oz.

```
      cwt. qr. lb. oz.
        7   1  10   0  one cask.
                12     casks.
lb.   ————————————————
16   [illegible]  0   8  [illegible] gross.
       12  [illegible]  9   2  tare.
      ————————————————
       75   1  26  14  Answer.
```

LESSON 4.

[illegible] barrels of potash each 400 lb. gross, tare 12 lb. per [illegible] how much neat weight? Ans. 3214 lb. 5 oz.

```
400 lb. 1 barrel.   lb.G.  lb.T.  lb.G.
  9 barrels.         112  :  12 :: 3600
———                                  12
3600 gross.                        ————
                       112)43200(385 lb. tare.
```

[*Continued.*

112)43200(385 lb. tare.
336
.960
896
.640
560
80 lb.
16 oz. in a pound.
[illegible])1280(11 oz. tare.

	lb.	oz.
Gross	3600	00
Tare	385	11
Neat	3214	5

When Tret [illegible]

RUL[illegible]

Divide the suttle by 26, su[illegible] suttle, the remainder will be nea[illegible]

LESSO[illegible]

In 17 boxes of sugar, weighing [illegible] 2 qrs. gross, tare 176 lb., tret 4 lb. on every [illegible] cwt. neat? Ans. 114 cwt. 1 qr. 12 lb.

120 cwt. 2 qr. gross.
[illegible]
482
28
3856
964
13496 lb. gross.
176 lb. tare.
13320 lb. suttle.
512 lb. tret.
12808 lb. neat.

Tret[illegible]
26)1[illegible]
130
32
26
60
52
[illegible]8

lb. neat.
Pounds in 1 qr. 28)12808(457 qrs.
112
160 4)457
140 cwt. 114 1 qr.
208
196
12 lb.

CASE 5.

When Tare, Tret and Cloff are allowed.

RULE.

Deduct the tare and the tret as before, and call the remainder suttle; divide this suttle by 168; the quotient will be the cloff; subtract the cloff from the suttle, the remainder will be neat.

LESSON 6.

What is the neat weight of a tierce of tobacco, weighing 8 cwt. 1 qr. 20 lb. gross; tare 14 lb. per cent., tret 4 lb. per 104, and cloff 2 lb. per 3 cwt.?

Answer, 7 cwt. 0 qr. 5 lb. 9 oz.

	cwt.	qr.	lb.	oz.	
14 lb. $\frac{1}{8}$ of cwt. ÷	8	1	20	0	gross.
	1	0	6	0	tare.
lb. $\frac{1}{26}$ part. ÷	7	1	14	0	
		1	3	12	tret.
$\frac{1}{168}$ part. ÷	7	0	10	4	suttle.
			4	11	cloff.
	7	0	[illegible]	9	neat.

END OF PART TENTH.

INTRODUCTION TO ARITHMETIC.

PART XI.

CONTAINING,

EXTRACTION OF THE SQUARE ROOT, OF THE CUBE ROOT, AND SINGLE AND DOUBLE POSITION.

EXTRACTION OF THE SQUARE ROOT.

A *square* is the product of a number multiplied by itself; as, $4\times4=16$; here 16 is the square of 4: This is called *Involution*; and when this sign is inserted $\urcorner^2$ it signifies, the square of any number is required, as, $\urcorner^2\ 4$, is as much as to say, "multiply 4 by itself," or, "the square of 4."

The *Square Root* is a number extracted, which being multiplied by itself will produce the given number it was extracted from; as, the square root of $16=4$; and this root 4 multiplied by itself, will produce its resolvend or div[illegible] 16. Extraction of Roots is called *Evolution*; and when the square root of any number is required, it may be signified by this mark placed before the number thus, $\sqrt{16}$; that is to say, "the square root of 16."

A TABLE OF ROOTS AND SQUARES.

Roots,	1	2	3	4	5	6	7	8	9
Squares,	1	4	9	16	25	36	49	64	81

The dividend is commonly called the Resolvend.

The quotient is the Root.

That root which can be found to exactness, is a *rational* root.

That root which cannot be found to exactness, is a *surd*.

en odd places are given in the decimals, make then by annexing ciphers.

hen a root proves to be a surd, annex ciphers by pair e fraction is reduced to a sufficient degree of minute

hen preparing the dividend for extraction, begin wit integers at units and count two figures to the left, the e a distinction; then count two more, and continu s operation till the whole numbers are marked into pair egin again with the decimals, and proceed to the rig arking them also into pairs.

EXAMPLES.

LESSON 1.

What is the square root of 62750.25?

Point off the work thus, $\left\{\begin{array}{l} \text{a b c d} \\ 6{,}27{,}50.25, \end{array}\right.$

```
   a b  c  d    root
 √ 6,27,50.25,(250.5
   4
 e —
 45)227
    225
f   —
5005).25025
      25025
      —————
```

Point off so many decimals in the quotient or ro there are pairs in the fractions.

In this case there is one pair in the decimals, th we point off one figure in the root for decimals.

OPERATION WITH WORDS.

First seek the root of 6; it must be 2; place 2 in the quotient; multiply it by itself; set its squar 6; subtract, the remainder is 2.

Second: Bring down 27 from under *b* to the r makes 227 for a new dividend: Multiply the quo makes 4; place this 4 for a divisor as at 4 unde how many times 4 in the dividend, excepting always the right hand figure; say 5 times; place 5 on the right side of 4, for a new divisor, also place 5 in the quotient as under *o*; then multiply as in Long Division, and place the product 225 under 227; subtract, the remainder is 2.

Third: Bring down the pair 50 from under *c* to the right side of 2, makes 250; double the quotient and place the product as at 50 under *f*, for a divisor; seek how many times 50 in 250, rejecting the right hand figure in the dividend; set no times or cipher in the quotient on the right side of 5 under *o*, and place a cipher also in the divisor at the right hand of 50 under *f*, which cipher will make the divisor 500.

Fourth: Bring down the pair 25 from under *d*, to the right side of 250, makes 25025 for a new dividend; seek how many times 500 in 25025, rejecting the right hand 5 in the dividend; say 5 times; set 5 on the right hand of the divisor 500 under *f*, makes 5005 for a new divisor, and place 5 under *t*, multiply the divisor by the quotient figure, as in Long Division, and place the product under 25025. The root or answer is 250.5

Proof of Lesson 1.

RULE.

Multiply the root by itself, the product will be the same as the resolvend or dividend.

┐^{2}250.5
250.5
———
12525
125250
5010
———
Proof, 62750.25

LESSON 2.

What is the square root of 21377.071681?

2,13,77.07,16,81(146.209
1
g. ——   Ans. 146.209
24)113
96
h. ——
286)1777
1716
i. ——
2922)6107

Continued.

```
     2922)6107
          5844
   k.    ——————
292409).2631681
        2631681
        ———————
```

OPERATION WITH WORDS.

First: Seek the root up to the first comma; the root of 2 is 1: place 1 in the quotient and 1 under the first figure 2; subtract, the remainder is one.

Second: Bring down the pair 13 to the right side of 1, makes 113 for a new dividend; double the quotient figure 1 and place the product for a divisor as at 2 under *g*. seek how many times 2 in the new dividend 113, rejecting the right hand figure 3; say 4 times; set 4 in the quotient; set 4 also on the right of 2 under *g*, makes 24 for a new divisor; multiply this divisor by the last figure 4 in the quotient; set the product 96 under 113; subtract, the remainder is 17.

Third: Bring down the pair 77 to the right side of 17, makes 1777 for a new dividend; double the 14 in the quotient makes 28; place 28 for a divisor as under *h*. seek how many times 28 in 1777, rejecting the right hand 7; say 6 times; set 6 in the quotient at the right side of 14; and place 6 also on the right of the divisor 28, which makes 286 for a new divisor; multiply as in Long Division, and place the product under 1777; subtract; the remainder is 61.

Fourth; Bring down the pair 07 to the right side of 61, makes 6107 for a new dividend; double the three figures in the quotient; set their product for a divisor as at 292 under *i*; seek how many times 292 in 6107; say 2 times; place 2 in the quotient on the right of 6; place 2 also on the right of 292, makes 2922 for a new divisor; multiply as in Long Division, and place the product under 6107; subtract, the remainder is 263.

Fifth: Bring down the pair 16 to the right side of 263, makes 26316; double the four figures in the quotient and set their product for a divisor as at 2924 under *k*; seek how many times 2924 in 26316, rejecting the right hand 6; say no times; set a cipher in the quotient and another on the right of 2924, makes 29240.

Sixth: Bring down the pair 81 to the right side of 26316, makes 2631681 for a new dividend; seek how many times 29240 are in the dividend, rejecting the right hand figure 1; say 9 times; set 9 in the quotient and at the right of the cipher in the divisor, makes 292409; multiply as in Long Division and set the product under 2631681.

Now because there were 3 pairs in the decimals we will point off three decimals in the root: This gives for the root, 146.209; which if multiplied by itself, will produce the number it was extracted from, 21377.071681

LESSON 3.

What is the square root of .75? Ans. .866+

```
     √.75,00,00(.866
       64
      ----
  166)1100
       996
      -----
  1726)10400
       10356
       -----
Rem.      44
```

Surds are marked with the sign + more.

PROOF OF LESSON 3.

```
⌉² the Root  .866
             .866
             ----
             5196
            5196
           6928
           -------
           .749956
Remainder added,  44
           -------
         - .750000
```

LESSON 4.

If an army consist of 222784 men, how many will each side contain when they are placed in form of a solid square?

Answer, 472.

$\surd$ 22,27,84.(472
16

87).627
609

942).1884
1884

LESSON 5.

How large a square room may I floor with 5625 feet of plank?

Ans. 75 feet square.

$\surd$ 56,25(75 root or answer.
49

145).725
725

LESSON 6.

An irregular field of corn contains 197136 hills; how many hills must be placed in a row when the whole are formed into a square field?

Ans. 444.

$\surd$ 19,71,36(444 root or answer.
16

84).371
336

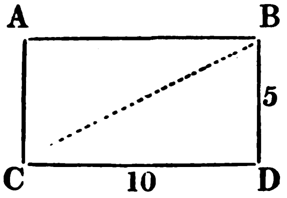
884).3536
3536

LESSON 7.

How long is the diagonal line of a field, in form of a parallelogram, 10 chains one way and 5 the other?

Ans. 1118 links + or 11 ch. 18 links +

Note 1. A diagonal line is a line drawn from corner to corner, as C B, dividing this figure into two right angled triangles.



2. A parallelogram is an oblong or long square, as A B C D.

3. A right angle or corner contains 90 degrees, and is in the shape of a carpenter's square.

4. An angle greater than 90 degrees, is an *obtuse* angle, that is, *dull, blunt*, not sharp pointed.

5. An angle less than 90 degrees, is an *acute* angle, that is, a corner sharp pointed.

6. The diagonal line aforesaid is also the hypothenuse to the triangle, C B D.

7. The sides of right angled triangles are called legs; the side C D is the longest leg, or *base;* the line from D to B is the shortest leg or *perpendicular.*

Now let us find the length of the diagonal or dotted line, that is, the hypothenuse to the triangle C D B.

RULE.

Add the squares of the two legs, and extract the Square Root of their sum.

The leg C D	10	chains.
	10	
Square of C D	100	
	25	square of D B.
	125	sum of the squares.

$\urcorner^2$ of D B 5 = 25.

ch.
$\surd$ 1,25.(11.18 + root or answer.
1

21)025
21

221)400*
221

2228)17900*
17824

Remainder, ...76

Proof.
$\urcorner^2$ 11.18
11.18

8944
1118
12298

1249924
Remainder, 76

Proof, 125.0000

LESSON 8.

The wall of a fort is 24 feet in height, and a ditch of 12 feet wide surrounds the fort; I wish to know the length of a ladder that will reach from the outer edge of the ditch to the top of the wall? Ans. 26.83 + feet.

The longest leg $24 \times 24 = 576$
The short leg $12 \times 12 = 144$

Sum of the squares, 720 feet.

$\surd$ 7,20.00,00,(26.83 + feet.
4

46)320
276

528)4400
4224

5363)17600
16089

Remainder, 1511

26.83
12

in. 9.96
12

11″.52
12

6‴.24

In this case, the height of the wall is the longest leg, the distance from the bottom of the wall to the outer edge of the ditch the short leg, and the length of the ladder the hypothenuse.

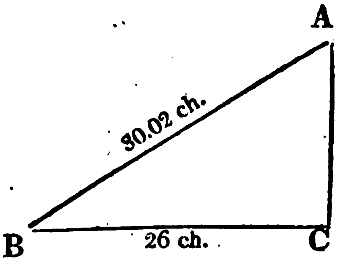
LESSON 9.

The hypothenuse and one leg or side of a triangle given, to find the other side.

RULE.

From the square of the hypothenuse, subtract the square of the given leg; the square root of the difference, is the length of the leg required.

In the triangle A B C, the hypothenuse A B, 30.02, and the side B C 26, are given to find the perpendicular A C.



The hypothenuse 3002 links.

The base B C, 26.00 — 3002
26.00 — 3002
6004
156 — 900600
52
6760000 — 9012004 square.
6760000

Difference, $\surd$ 2,25,20,04(1500 links, Ans.
1
25)125
125
3000)...2004

1500 links=15 chains the length of A C.

LESSON 10.

A steeple 120 feet in height has a ladder of the same length placed with the foot 20 feet from the bottom of the steeple, on a level surface; how far does the top of the ladder come below the top of the steeple?

Answer, 1 foot 8 in. 1′ 11″+

In this case we must consider that two sides of a triangle are given to find the third: The ladder, 120 feet, is the hypothenuse, the distance the foot stands from the steeple, 20 feet, is the short leg of the triangle, and that part of the steeple from the foundation to the top of the ladder is the leg sought; subtract this leg, when found, from the height of the steeple, the difference will be the answer.

Operation.

Hypothenuse 120
120
Square, 14400
Short leg, 400
Diff. $\surd$ 1,40,00(118.32 feet from the foundation to the [top of the ladder.
1
21)040
21
228) 1900
1824
2363)..7600*
7089
23662) .51100*
47324
.3776

The short leg 20
20
Square 400

Height of steeple, 120. ft.
118.32
Difference, 1.68
12
in. 8.16
12
sec. 1.92
12
thirds 11.04

LESSON 11.

If I have 300 apple trees, and wish to set them two rods or 50 links apart, on a piece of land in form of a parallelogram, whose length and breadth shall be as 4 to 3, how many trees must stand on the length, and how many on the breadth? And, how many acres of ground will they require?

Answer, { 20 trees in length, and 15 in breadth.
6 acres, 2 roods, 24 perches.

RULES.

1. As the ratio in breadth,
   is to the ratio in length;
   So is the number of trees,
   to a fourth number.

2. As the ratio in length,
   is to the ratio in breadth;
   So is the number of trees,
   to a fourth number.

3. Extract the square root of each fourth number, and you will have the number of trees sought.

OPERATION.

As 4 in length is to 3 in breadth, and
As 3 in breadth is to 4 in length.

B. L. Trees.	L. B. Trees.
3 : 4 :: 300	4 : 3 :: 300
4	3
3)1200	4)900
√ 400(20 L.	√ 225(15 B.
4	1
40).00	25)125
	125

To find the quantity of land.

RULE 4.

As 1 : is to the distance apart ::
So is the number in length less 1 :
to a fourth number.

RULE 5.

As 1 : is to the distance apart ::
So is the number in breadth less 1 :
to a fourth number.

RULE 6.

Multiply the two fourth numbers together, the product will be the quantity of land.

Trees in breadth 15—1=14. Distance apart 50 links.
Trees in length 20—1=19. Distance apart 50 links.

T. B. T.	T. L. T.
1 : 50 :: 14	1 : 50 :: 19
50	19
4th number for the breadth, 700	4th no. for length, 950

950 length.
700 breadth.

6|65000 links = 6 A. .65
4
Roods 2.60
40
Perches 24,00

LESSON 12.

Let 6400 men be formed in solid column, with 4 times as many in file as in rank; how will they stand?

Ans. 40 in rank and 160 in file.

RULE.

The Square Root of one fourth of the men will give the number in rank; and the number in rank multiplied by the ratio 4, will give the number in file.

OPERATION.

$6400 \div 4 = 1600$. $\sqrt{1600} = 40$ rank.
$40 \times 4 = 160$ file.

16,00(40 root.
16
80)..00

LESSON 13.

Let 17298 men be so formed that the number in rank will be double the number in file.

Answer, 186 in rank and 93 in file.

MODE OF OPERATION.

$17298 \div 2 = 8649$. $\sqrt{8649} = 93$ in file.
93 in file $\times 2 = 186$ in rank.

LESSON 14.

The area of a circle contains 176.4 acres; how long is the side of a square farm which will contain the same quantity of land? Ans. 42 chains.

In this case reduce the acres into links by annexing four cyphers to the decimal .4, which will be the same as annexing five cyphers to whole numbers of acres.

OPERATION.

$\sqrt{}$ 17,64,00,00(4200 links = 42 chains for one side
16 [of a square field.

82).164
164

8400)...0000

LESSON 15.

The area of a circle given to find the diameter.[*]

RULE.

Multiply the Square root of the area by 1.12837: or,

Multiply the area by 1.273241, the product will be the square of the diameter; consequently the Square Root of that product will be the diameter.

EXAMPLE.

The area of a circle contains 113.09 superficial inches; how long is the diameter?

Ans. 11.999 inches, or 12 inches nearest.

---

[*] *Diameter* is the longest line across a circle.
Semidiameter is half the diameter.
Periphery, or *Circumference*, is the line round the circle.

OPERATION.

√ 1,13.09(10.634 root.
1

206).1309
1236

2123)..7300*
6369

21264) .93100*
85056

.8044

Com. mul. 1.12837
Root, 10.634

451348
338511
677022
1128370

Answer, 11.99908658

LESSON 16.

The diameter of a circle given to make another circle 2, 3 or 4 times greater.

RULE 1.

Multiply the square of the diameter by the given proportion, and extract the square root of that product for an answer.

EXAMPLE 1.

If the diameter of a circle be 12 inches, what will be the length of the diameter of a circle 4 times as large?

Answer, 24 inches.

12 × 12 = 144 the square of the diameter.
4 the proportion.

√ 576(24 inches, answer.
4

44)176
176

RULE 2.

If the required circle be less than the one given, then *divide* the square of the diameter of the given circle by the proportion and extract the square root of that quotient for an answer.

EXAMPLE 2.

The diameter of a circle is 24; required the diameter of a circle 4 times less. Answer, 12.

$24 \times 24 = 576 \div 4 = 144 \surd$ of which is 12 the answer.

NOTE 1.—*To find the diameter and circumference of a circle the one from the other.*

Multiply the diameter by 3.1416. the product will be the circumference:

Therefore,

Divide the circumference by 3.1416 and the quotient will be the diameter.

NOTE 2.—*When the diameter is given to find the area of a circle.*

RULES.

RULE 1.—Multiply the square of the diameter by .785398.

Or,

RULE 2.—Multiply the square of the semidiameter by 3.1416. Or,

RULE 3.—Multiply half the circumference by half the diameter. Or,

RULE 4.—Multiply the square of the diameter by .7854, the product in either case will be the area.

NOTE 3.—*To find the area of an Ellipsis or Oval.*

RULE.

Multiply the *transverse* diameter by the *conjugate* and their product by .7854, the last product will be the area of the Ellipsis.*

LESSON 17

The conjugate and transverse diameters of an Ellipsis given to find the diameter of a circle equal in area.

RULE.

Multiply the two diameters of the ellipsis together, and the square root of their product will be the diameter of a circle equal in area, to the ellipsis.

---

* *Conjugate* diameter is the longest line passing through the centre of an oval.

Transverse diameter is the shorter line passing through the centre of an an oval at right angles with the *conjugate*.

EXAMPLE.

The area of an ellipsis is 1244 inches, the conjugate diameter is 44 and the transverse is 36; of what length must be the diameter of a circle equal in area? 39.8 inches nearly.

Operation.

Conjugate, 44	15,84(39.8 nearly.
Transverse, 36	9
264	69(684
132	621
Product, 1584	788).6300*
	6204

Proof for Lesson 17.

Work by Note 2, *and Rule* 4, *under Lesson* 16.

Diameter, $\overline{|}^{2}$ 39.8
39.8

3184
3582
1194

1584.04 square of diameter.
.7854 common multiplier.

633616
792020
1267232
1108828

1244.105016 area.

Here note, if the diameter of the circle had been carried further in the decimal parts, say .79 instead of .8, the proof would have come out more exactly.

QUESTIONS FOR EXERCISE.

LESSON 18.

If a pipe $\frac{1}{4}$ of an inch diameter, will fill a cistern in 4 hours, what must be the diameter of another pipe which will fill the same cistern in 2 hours.

Answer, $4'' \; 2''' \; 10''''$ or .35355 + of an inch.

RULE.

As the time given,
is to the square of the given diameter;
So is the time required,
to the square of the required diameter.

OPERATION.

As 4 hours are to $\rceil^2$ of .25, so are 2 hours to $\rceil^2$ of the diameter required. *Inverse Proportion.*

½ of an inch = .25
.25
125
50
.0625 square of the given diameter.

Time given. Sq. Time required.
4 : .0625 : : 2
4
2)2500
√ .12,50(.35355+ of an inch.
9
65)350
325
703).2500
2109
7065).39100
35325
7070).377500

.35355
12
Seconds, 4.24260
12
Thirds, 2.91120
12
Fourths, 10.93440

LESSON 19.

If a pipe of ½ an inch diameter will fill a cistern in 8 hours, in what time will a pipe whose diameter is 1½ inch fill the same cistern? Ans. 53 min. and 20 sec.

When the answer consists of time, the second term will be in time; and the first and third terms in squares of given diameters.

½ an inch = .5
.5
—
.25 square of the half inch pipe.
$\overline{|}^{2}$ of 1½ = 2.25

Diam. h. Diam.
.25 : 8. : : 2.25 inversely.
8
—
2.25)2.0000000(.88888 of an hour.
1800
—
.2000
1800
—
.2000
1800
—
.2000
1800
—
.2000

.88888
60
—
min. 53.33280
60
—
sec. 19.96800
20 nearest.

LESSON 20.

If 4 pipes of 3 inches diameter each, will be 4 hours in discharging a cistern of water, what time will 3 pipes of 4 inches diameter, require to discharge another cistern, which contains 5 times that quantity? Ans. 15 hours.

3 inches diam.
3
—
9 square of diam.
4 number of pipes.
—
36 sum of the squares.

4 inches diam.
4
—
16 square of diam.
3
—
48 sum of the squares.

Diam. h. Diam.
36 : 4 : : 48 inversely.
4
—
48)144(3 hours.
144

cis. h. cis.
1 : 3 : : 5 directly.
3
—
15 Answer.

LESSON 21.

In the midst of a meadow well cover'd with grass,
I will take just two acres to tether my horse;
How long must the cord be, when he's feeding around,
To command him within these two acres of ground?

Answer, 252.313+ links: or, 166 ft. 6 in. 4 sec.

See the rules under lesson 15.

Common multiplier, 1,273241
Links in 2 acres, 200000

✓ 25,46,48,20,00,00(504.626+
25

1004) 4648
4016

10086) 63220
60516

100922) 270400
201844

1009246). 6855600
6055476

.800124

Diameter, 504.626+
Semidiameter, 252.313 or length of the cord.

1 link = 7.92 inches. .313 of a link = 2½ in.
.313

2376
792
2376

2.47896 = 2½ inches nearest to be added to the 252 links.

Proof of Lesson 21.

By Note 2. *Rule* 4 *under Lesson* 16.

Diameter, $\rceil^2$ 504.626
504.626

See page 336.

3027756
1009252
3027756
2018504
25231300

Square, 254647.399876
Common Multiplier, .7854

1018589599504
1273236999380
2037179199008
1782531799132

200000.0678626104

LESSON 22.

A and B in partnership bought a grindstone which contained 3 feet in diameter; after making an allowance for for the eye, 4 inches by 3, the parties agreed that A should grind off one half first; how many inches of the diameter must A wear off for his part?

Answer, 10 inches 5 seconds 7 thirds.

First consider we have a diameter given to find the area. See rule 4, under note 2, lesson 16.

The diameter is 3
3
Square of the diameter, 9
Common multiplier, 7.854
Area including the eye, 7.0686

The eye containing 12 superficial inches, or $\frac{12}{144}$ of a foot must be reduced to the decimal of a foot and subtracted from the area which will give a new area.

$\frac{12}{144}$ reduce 144)12.0000(.0833
1152 [area of the eye.
00480

00480
432
.480
432
.48

Area including the eye, 7.0686 feet,
Area of the eye, .0833

New area excluding the eye, 6.9853

Here 6.9853 is an area given to find the diameter. When found, we will call it "a new diameter." *See Rule under Lesson* 15.

New Area.
√ 6.98,53(2.64 Root of the new area.
4
46)298
276
524).2253
2096
.157

Common multiplier, 1.12837
Root of new area, 2.64
451348
677022
225674
New diameter, 2.9788968

Now we have a new diameter given to form another which will make a circle half as large in area for B's part.

See Rule 2, *above example* 2, *under Lesson* 16.

The new diameter, 2.9788968
2.9788968
238311744
178733808
268100712
238311744
238311744
208522776
268100712
59577936
8.87382614505024

This square of the new diameter must be divided by the proportion 2; that is done to make another circle half as large by extracting the Square Root of the quotient.

2)8.87382614505024
4.43691307252512 half the square.

Carried forward.

To prove this operation, find the area of B's part by Rule 4, under Note 2, in Lesson 16.

B's part must be equal to half the new area after the eye was deducted.

√ 4.43,69,13,07,25,25,12

4

Root, (2.1063981 or B's diameter, which subtracted from the new diameter gives a remainder for A's part.

41)43
41

4206)26913
25236

42123)167707
126369

421269)4133825
3791421

4212788)34240425
33702304

42127961)53812112
42127961

11684151

New diam. 2.9788968
B's diam. 2.1063981

A's diam. .8724987
12

Inches, 10.4699844
12

Seconds, 5.6398128
12

Thirds, 7.6777536

LESSON 23.

Suppose a ship sail from New-York 4000 miles south, then east 6000 miles; how far will she be from New-York on a direct course, and what will be the course back?

Ans. the ship will be 7211 miles from New York, and the course back will be N. 56° 19′ W.

See Rules under Lesson 7.

One leg of the triangle, 4000
4000

Square, 16000000
Square of the other leg, 36000000

Sum of the squares, √ 52,00,00,00(7211 answer.
49

142).300
284

1441).1600
1441

14421).15900
14421

.1479

Rule to find the course.

As the sum of the hypothenuse and half the longest leg, is to 86 degrees;
So is the short leg, to its opposite angle.

The longest leg is 6000 miles.

Half the longest leg is 3000 miles.
The hypothenuse is 7211

The sum of the hypothenuse and half the longest leg is } 10211

Sum, &c. Short leg.
10211 : 86 : : 4000
4000

10211)344000(33 degrees.
30633

.37670
30633

.7037
60 minutes in a degree.

10211)422220(41 minutes.

[Continued.

10211)422220(41 minutes.
40844

.13780
10211

..3569

33 degrees and 41 minutes is the angle sought.

Subtract this angle from 90, the remainder will be 56 degrees, 19 minutes, the course to steer back.

90°
33 41′

56 19

Navigators calculate by Points: 11¼, 11.25, or 11 degrees 15 minutes make 1 point, 32 points the whole circle or 360 degrees.

11.25 degrees.
32 points.

2250
3375

360.00 degrees.

LESSON 24.

The *sum* of two numbers and their *product* given to find each number.

The *sum* of two numbers when added together is 61, and their *product* is 624; what are those two numbers?

Answer, 13 and 48.

RULES.

1. Square their sum, $61 \times 61 = 3721$
2. Subtract 4 times their product, from their square. $624 \times 4 = 2496$

3. Extract the square root of the remainder, $\sqrt{12,25}$(35
9

65)325
325

4. Halve the root and halve the sum. 61÷2=30.5
35÷2=17.5

5. Add the half root to the half sum to produce the greater number. 30.5
17.5

The greater number, 48.0

6. Subtract the half root from the half sum to produce the lesser number. 30.5
17.5

The lesser number, 13.0

CUBE ROOT.

A plain and improved method of extracting the Cube Root.

A TABLE OF CUBES.

Roots, 1	2	3	4	5	6	7	8	9
Cubes, 1	8	27	64	125	216	343	512	729

As in the Square Root we are obliged to distinguish the *square* from the *root*, so in the Cube, we must know the *cube* from the *cube root*; they being two distinct and very different objects.

EXAMPLE.

If the square of 4, that is, 16, be multiplied by 4, the last product 64 will be the *cube* of 4; and 4 will be the *cube root* of 64: How to extract this root, is now our task.

RULES.

1. Point off the work as in the Square Root, with this difference; point off three figures instead of two. Call these portions of figures *triplets*.

2. Find the greatest cube up to the first point on the left, and place its root in the quotient.

3. Place the cube thus found under those figures that are on the left of the first point: Subtract, and to the right of the remainder bring down the next triplet: Call this the *dividend*.

4. Square the quotient and multiply the square by 300; call this product the *triple square*.

5. Multiply the quotient by 30, and call the product the *triple quotient.*

6. Add the triple square and triple quotient, and call their amount a *divisor.*

7. Seek how oft the divisor is contained in the dividend, and set the result in the quotient.

8. Multiply the last quotient figure by the triple square, and place the product in a memorandum.

9. Multiply the square of the last quotient figure by the triple quotient, and place the product under the product of the triple square; and under the whole place the cube of the last quotient figure.

10. Call their sum total *the subtrahend,* which place under and subtract from the dividend: Then proceed with the residue of the work as before.

EXAMPLES.

LESSON 1.

What is the Cube Root of 12167? Ans. 23.

OPERATION.

```
       12,167(23 root          2 quotient.
        8                      2
       ----                    -
  1260)4167 dividend.          4 square of the quotient.
       4167 subtrahend.        300
       ----                    ----
       ....                    1200 triple square,      1200
                             2 quotient.
                             30
                             60 triple quotient,          60
                                     Divisor,           1260
                     1200 triple square.
                       3  last quotient figure.
                     ----                               ----
                     3600 product for memorandum,       3600
                     9  square of the last quotient figure.
                     60 triple quotient.
                     ---
                     540 product for memorandum,         540
                     Cube of the last quotient figure,    27
                     Subtrahend,                        4167
```

LESSON 2.

What is the Cube Root of 76.765625? Ans. 4.25

OPERATION.

76.765,625,(4.25 root.
64

4920)12765 4 quotient.
10088 4

530460).2677625 16 square of the quotient.
2677625 300

.... 4800 triple square, 4800

4 quotient.
30

120 triple quotient, 120

Divisor, 4920

2 last quotient figure.
4800 triple square.

9600 product for memorandum, 9600

2 last quotient figure.
2

4 square of the same
120 triple quotient.

480 product for memorandum, 480
8 cube of the last quotient figure, 8

Subtrahend, 10088

Quotient, 42
42

84
168

1764 square of the quotient.
300

529200 triple square.

[*Continued.*

529200 triple square.

42 quotient.
30

1260 triple quotient.
529200 triple square.

530460 divisor.

529200 triple square.
5 last quotient figure.

2646000 product for mem. 2646000

5 last quotient figure.
5

25 square of the last quotient figure.
1260 triple quotient.

6300
2520

31500 product for memorandum, 31500

5 last figure in the quotient.
5

25 square of the same.
5

125 cube of the last figure in the quotient, 125

Subtrahend, 2677625

Note.—The same rule holds good in the Cube Root, as in the Square Root, respecting pointing off decimals: point off so many decimals in the Root as there are triplets in the decimals of the given number. In the last Lesson there are two triplets, viz. 765,625,; therefore we point off two decimals in the root.

Again:—As in the Square root we annex two ciphers to remainders, so in the Cube Root we must annex three ciphers to remainders when running a decimal to a small value.

POSITION.

POSITION is called the Rule of False, because we can suppose and take false numbers to reason from, and thereby find the true number sought. This rule is divided into two parts, *single* and *double.*

SINGLE POSITION.

LESSON 1.

What sum being loaned at 6 per cent. per annum, simple interest, will amount to 1250 dollars in 10 years time?

Ans. $781 25 cts.

RULE.

As the *result* of the supposed number,
is to the *supposed* number;
So is the *given* number,
to the number sought.

OPERATION.

Suppose we lend 600 dollars at 6 per cent.

600 principal.
6 rate per cent.
36|00 interest 1 year.

36 interest 1 year.
10
360 interest for 10 years.
600 principal.
960 amount.

Now say—As the amount or result 960 :
is to its supposed number 600 : :
So is the given number 1250 :
to its original true number;
that is, the principal put to interest.

Am't. Prin. Am't.
960 : 600 : : 1250 to a fourth number.
600

960)750000(781.25 answer. [Continued.

```
960)750000(781,25 answer.
    6720
    ----
    .7800
     7680
     ----
     .1200
       960
      ----
       240.0*
       192 0
       -----
       ·4800*
        4800
        ----
```

LESSON 2.

The yearly interest of a sum at 6 per cent. is equal to $\frac{1}{10}$ part of the principal added to 250 dollars; what is the principal? Ans. $ 25000.

Suppose the principal to be	500 dollars.
Rate per. cent.	6
Interest for 1 year,	30|00
$\frac{1}{10}$ of 500 =	25
Excess only,	5 dollars.

Here the excess over $\frac{1}{10}$ is only five dollars interest instead of 250.

Now say, if 5 excess of interest, arises from 500 principal; what did 250 excess arise from?

```
5 : 500 :: 250 to a fourth number.
            500
           ----
        5)125000
   Ans.   25000
```

LESSON 3.

Of a certain sum lent, I received one fourth, one fifth, and one sixth, which amounted to 185 dollars; what was the sum lent? Answer, 300 dollars.

Suppose I lent 60 dollars.
¼ = 15
⅕ = 12
⅙ = 10
Result, 37

37 : 60 : : 185
185
37)11100(300 Ans.
111
...00

LESSON 4.

A and B have a salary each alike for 3 years; A saves ⅓ of his wages, but B spends the whole of his and one third more, falls in debt fifty dollars yearly, and at the end of 3 years, after settling his accounts, has only 20 dollars left of a present given by his uncle at the commencement of business; what was the salary? And how much the present? Answer, the salary was 150 dols. each.
The present was 170 dollars to B.

OPERATION.

Suppose the salary to be 6 dols.
The third of 6 = 2
B spends 50 dollars a year more than his salary for 3 years = 150 dol. and 20 he had left = 170 the present.

Result. Pos. Result.
2 : 6 : : 50
50
2)300(150 Sal.

LESSON 5.

On the 25th day of October 1815, while penning this lesson, I find that one fifth of the years I have lived, multiplied by 6, and the fourth of my years added to that product, make 87; what is my age? Answer, 60 years.

OPERATION

Suppose 80 years.
⅕ of 80 = 16
× 6
Product, 96
¼ of 80 = 20
Result, 116

R. Position. R.
116 : 80 : : 87
87
116)6960(60 Answer.
696
...0

DOUBLE POSITION.

LESSON 6.

Says George to Harry, I have a sum of money to buy books; the $\frac{1}{3}$ and $\frac{1}{2}$ a $\frac{1}{3}$ of which will make 4 dollars and 0 cents; if you will tell me how much I have, 2 dollars hall be yours. Answer, 9 dollars.

		R.	P.	R.
Suppose	12 dollars.			
The $\frac{1}{3}$ of 12 =	4	6 :	12 ::	4.50
The $\frac{1}{2}$ of 4	2			12
Result,	6			6)54.00
				Answer, 9.00

DOUBLE POSITION,

Is when we use two suppositions: and if we miss in both, observe the nature of the errors and work accordingly. When the errors are both less, or both greater than the given number, they are alike; but if one be greater and the other less than the given number, they are unlike.

RULES.

1. When the errors are *alike*, take their difference for a divisor, and the difference of their products for a dividend.

2. When the errors are *unlike*, take their sum for a divisor and the sum of their products for a dividend.

LESSON 7.

A B and C would divide 250 dollars between them in such manner that B may have 7 dols. 50 cents more than A, and C 10 dols. more than B; how much must each man have? Answer, A must have 75 dols. B, 82.50 and C, 92.5

Operation.

1st. Suppose A,	20	2nd. Suppose A,	40
B,	27.50	B,	47.
C,	37.50	C,	57.
Result,	85.00	Result,	14
Given number,	250.	Given number,	25
1st Error,	165	2nd. Error,	10

[Conti

Having proceeded according to the proportions mentioned in the question, and placed the suppositions and errors as here represented, multiply them crosswise, that is, multiply the first error by the last supposition, and the last error by the first supposition.

	Supposi.		Error.
1st.	20	╳	165
2nd.	40		105

First error,	165
Second,	105
Difference,	60 for a divisor.
First product,	6600
Second,	2100
Dividend,	4500

First error,	165
Last supposi.	40
1st product,	6600
Second error,	105
First supposi.	20
2nd Product,	2100

6|0)450|0

75.	A's part.
82.50	B's.
92.50	C's.
Proof, 250.00	

LESSON 8.

"A saddle is worth 50 dollars: two horses are of different value: when the saddle is on the first horse it raises his value to double the second; but when it is on the second horse, his value is triple the first: What is the value of each horse?

Ans. The price of the first horse is 30 dollars, and the second 40."

OPERATION.

1st. Suppose the first horse worth,	38 dol.
The saddle,	50
Their combined value,	88
The price of the second horse ½ of 88 =	44
The saddle,	50
Their combined value,	94
Three times the value of the first horse 38×3=114	
The difference between 114 and 94 is the first error,	20

2nd. Suppose the first horse worth,	42 dol.
The saddle,	50
Their combined value,	92
The price of the second horse ½ of 92 =	46
The saddle,	50
Their combined value,	96
Three times the value of the first 42×3=	126
The difference between 126 and 96 is the second error,	30

	Supposi.		Error.
1st.	38	X	20
2nd.	42		30

First supposition,	38
Last error,	30
First product,	1140
Second supposition,	42
First error,	20
Second product,	840
First product,	1140
Dividend,	300
First error,	20
Second,	30
Diff. or divisor,	10

10)300
30 first horse.
50 saddle.
80 saddle and horse.
40 second horse.
50 saddle.
90 saddle and horse three times the value of the first.

LESSON 9.

" A boy stealing apples being taken by mad Tom, gave over half he had stolen, and Tom gave him back 10; in his return home, he was met by raving Ned, who took from him one half of what he had left, and returned him back 4; after that, unluckily, positive Jack meets him, and takes away one half the remainder, giving back 1; at last getting safe away, he finds he has 18 left: How many had the boy at first? Answer, 100."

1. Suppose	124	2. Suppose	148
Tom took	62	Tom took	74
Gave back	10	Gave back	10
Leaves	72	Leaves	84
Ned took	36	Ned took	42
Gave back	4	Gave back	4
Leaves	40	Leaves	46
Jack took	20	Jack took	23
Gave back	1	Gave back	1
Leaves	21	Leaves	24
Given number	18	Given number	18
1st error, 21—18=	3	2nd error 24—18=	6

	Supposi.		Error.			
1st.	124	╳	3		744	first product.
2nd.	148		6		444	second product.
Diff. of errors,			3	÷ by 3.	300	difference.
					100	Answer.

END OF PART ELEVENTH.

INTRODUCTION TO ARITHMETIC.

PART XII.

CONTAINING,

MECHANICAL POWERS, EXERCISING QUESTIONS, A SECRET FOR TEACHERS, AND AN APPENDIX ON BOOK-KEEPING.

MECHANICAL POWERS

OF THE LEVER.

To find what weight may be raised by any given power.

RULE 1.

As the distance between the weight to be raised and
the *fulcrum*,*
is to the distance from the fulcrum to the end of the lever where the power is applied;
So is the power applied,
to the weight it will raise.

EXPLANATION.

As the shorter distance,
is to the longer;
So is the lesser weight,
to the greater.

We will suppose A to be the fulcrum of a lever 12 feet long: O, the weight to be raised, and P, the power applied.

---

* *Fulcrum*, is the point of suspension on which the lever bears. On steelyards, it is the short crossbar turning in the upper hook when weighing.

LESSON 1.

CASE 1.

If 140 pounds rest on the end of a lever 12 feet long, how many pounds will the said 140 balance at the other end, allowing the fulcrum to be placed 18 inches from the weight to be raised as at A? Answer, 980 pounds.

OPERATION.

12 feet the length of the lever.
1.5 = 18 inches from the fulcrum to the weight.

10.5 feet from the fulcrum to the end of the lever where the power is applied.

lesser, greater. lesser.
1.5 : 10.5 : : 140 to a
140 [fourth number.
420
105
1.5)14700(980 lb. weight [raised.
135
.120
120
...0

CASE 2.

If 140lb. be placed on the end of a lever 10.5 feet from the fulcrum, and at the same time balance 980lb. at the other end, what is the length of the lever from the fulcrum to the weight so balanced?
Ans. 18 inches.

OPERATION.

greater. lesser. greater.
980 : 140 :: 10.5 to a fourth
140 [number
420
105
980)1470.0(1.5 ft.

980)1470.0(1.5 ft. Ans.
980
4900
4900
....

CASE 3.

If we have an object of 980 pounds to raise with a lever 12 feet long, and the fulcrum is placed 18 inches from the foot of the lever, so that we have 10.5 feet for the long preponderating part, how many pounds must be applied to the long end to balance the said 980lb.? Ans. 140.

OPERATION.

greater. lesser. greater.
10.5 : 1.5 : : 980 to a 4th
980 [number.
120
135
10.5)14700(140lb. to be [applied.
105
.420
420
...0

RULE 2.

Divide the distance from the fulcrum to the power applied by the distance from the fulcrum to the weight raised; then multiply that quotient by the power applied, the product will be the weight raised.

EXAMPLE

10.5 ft. distance from the fulcrum to the power applied.

```
1.5)10.5(7 the quotient.
    105                    140 the power applied.
    ----                     7 the quotient for a multiplier.
                           ---
                           980 the weight raised or balanced.
```

OF THE WHEEL AND AXLE.

How to find a proportion in raising a greater weight suspended from the Axle than that applied to the wheel.

RULES.

1. As the diameter of the axle,
   is to the diameter of the wheel;
   So is the power applied to the rim of the wheel;
   to the weight raised by the axle.

2. As the lesser diameter,
   is to the greater diameter;
   So is the lesser weight applied on the wheel,
   to the greater weight suspended from the axle.

And to the contrary:

3. As the greater diameter,
   is to the lesser;
   So is the greater power suspended from the axle,
   to the lesser applied to the wheel.

CASE 1.

Suppose the diameter of the axle be 4 inches, the diameter of the wheel 48 inches, and 2 pounds are applied to the rim; how many pounds suspended from the axle will balance those 2 pounds? Answer 24.

OPERATION EXPLAINED.

As 4 the lesser diameter : is to 48 the greater : : so is 2 the lesser power : to the greater power to be raised by the axle.

Lesser. Greater. Lesser.
4 : 48 : : 2 to a fourth number.
2
4)96
24 pounds raised by the axle.

CASE 2.

If a wheel be 48 inches in diameter, the axle 4 inches, and 24 pounds are suspended from the axle, how many pounds must be applied to the rim of the wheel to balance the 24 pounds? Answer, 2 pounds.

As 48 the greater diameter, is to 4 the lesser; so is 24 the greater power, to the lesser.

Greater. Lesser. Greater.
48 : 4 : : 24 to a fourth number.
4
48)96(2 pounds, answer.
96

CASE 3.

If 120 pounds be suspended from an axle of 6 inches in diameter, and we have 10 pounds power to apply to the rim of the wheel, how many inches in diameter must the rim be that the 10 pounds will balance the 120?

Answer, 72 inches.

OPERATION EXPLAINED.

As 10 pounds the lesser power : is to 120 the greater : : so is the lesser diameter : to the greater.

Lesser. Greater. Lesser.
10 : 120 : : 6 to a fourth number.
6
10)720(72 inches, diameter of the wheel.

SELF-MOVING MACHINE.

Sir Isaac Newton observed, that "if ever the art of making a perpetual motion should be discovered, it would be by some novice of inferior literary acquirements:" a very just observation undoubtedly; for, modern scholars have so much pomp and vain-glory to maintain, that they have but little time to spare for the good of rising generations: but let us attend to our subject.—Suppose a wheel to be of 20 feet diameter, with buckets some like the conductors of a flour-mill; and on the shaft by the side of this wheel let there be another small wheel, of about 4 or 5 feet in diameter, with cogs projecting outwardly; let there be two other small wheels, of a cylindrical form, rather smaller than the last mentioned, and place one of them directly above, and the other below the cogwheel, so that they all three shall stand in a direct line perpendicularly: let there be a strap with holes suitably formed to fay on those cogs, and let there be conductors on the strap to carry weights or balls, received from the bottom of the large wheel, to the top of the same, and into a conductor which will convey said balls to the buckets of the large wheel. To increase the velocity of the strap, add a small wheel to the cogwheel.

If Readhefar* had embraced this principle it would have saved him much credit, and would have at least improved his skill in making running-gears for complicated machinery, if the project of perpetual motion had failed.

Note.—This plausible theory originated by calculating the powers of the wheel and axle; but it is not delivered to the world as infallible or warrantable. However, if this project should fail, another may be tried with Magnetism, which still holds out an idea as plausible as the first. If Magnetism can be placed in such position or positions, as will destroy the counter attraction, or so that the attractive power will draw up on one side of the wheel, while the propelling power on the other side drives downward; then you may pronounce it an auxiliary which will bring about the desired effect.

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* A man by the name of *Readhefar*, in the state of Pennsylvania, on or about the year 1813, undertook to exhibit a perpetual motion; but with all

OF THE SCREW.

How to find the proportion in raising by a Screw, a weight greater than that of the power applied to the Lever.

INTRODUCTION.

When operating with a screw, we use a lever with the power applied to the end; and this end of the lever in going round describes a circle: multiply the length of the lever by 2, the product will be the length of the diameter of said circle. By Rule, page 331, multiply the diameter of a circle by 3.1416, or by 3.14159, the product will be the circumference.

RULES FOR THE SCREW.

1. As the circumference described by the end of the lever where the power is applied,
is to the distance the threads of the screw are apart;
So is the weight to be raised,
to the power applied to the end of the lever.

LESSON 1.

If the threads of a screw be 2 inches apart, and we wish to raise 20 hundred weight with a lever 36 inches long, how great a power must be applied to the end of the lever?

Answer, 19.8 pounds.

EXPLANATION.

36 inches the lever × 2 = 72 the diameter of a circle described by turning said lever.

3.1416 common multiplier.
72 diameter.

62832
219912

226.1952 circumference described by the lever.

Threads of the screw 2 inches apart.

20 hundred × 112 = 2240 pounds to be raised.

his ingenuity in attempting to deceive the public, and gain a considerable sum of money to himself, he was detected by the celebrated Robert Fulton.

OPERATION.

Circumf. inch. lb.
226.195 : 2 : : 2240 to a fourth number,
2

226.195)4480.0000(19.8 pounds.
226195

2218050
2035755

.1822950
1809560

..13390

RULE 2.

As the distance between the threads of the screw,
is to the circumference;
So is the power at the end of the lever,
to the weight raised.

LESSON 2.

Suppose the threads of a screw are ½ or .5 of an inch apart, the length of the lever 15 inches, and a power of 10 pounds be applied to the end of the lever, how many pounds will be raised or supported in equilibrium by the screw, making no allowance for friction?

Answer, 1884.96 pounds.

OPERATION.

Lev. 15×2=30×3.1416=94.2480 circumference.
in. circumf.
.5 : 94.248 : : 10 to a fourth number.
10

.5)942.480
1884.96 lb. in equilibrium.

OF FRICTION.

This is a power of resistance generated by the rubbing of one thing against another.

The whole of the preceding calculations are independent of friction; for they are computed upon the same principle as though no such power existed. Yet in every of those operations with the lever, the wheel and axle, and the screw, less or more friction will be generated and become a power of resistance. It is rational to suppose that the least friction in these cases will arise from the lever; the next least from the wheel and axle, and a greater from the screw.

The *proportion* of friction is defined by philosophers thus, "It is in proportion to the weight and velocity,* conjointly, of the moving body." But suppose we should say, *The friction of a moving body is in proportion to its weight, velocity, and formation, jointly considered.*—We naturally suppose that different forms or shapes of a body, will cause different degrees of friction: It may be true, that, a cubic polished body of metal will move on a level smooth surface with the same power applied as it would when formed into a parallelogram, or into a square plate of one third the thickness of the *cubic* form.† But can we suppose that a lever on the edge of a fulcrum of suitable thickness, will create a resisting power by friction equal to the friction of a screw in raising the same weight, allowing the lever, the fulcrum, and screw, to be of one degree of hardness?

Experience and experiments must enable us to decide on such intricate and unascertained niceties.—The laws of friction are so various, that several pages of tables would be filled in elucidating its different powers in different operations: and then an infinity of intervening cases might happen, where new rules would become necessary. For, by experiments it has been ascertained that friction increases with the increase of weight, called *gravity*, of a moving body, but not in proportion to the additional weight or gravity: and to the contrary, it decreases with the decrease of weight, but not in proportion to the weight deducted. Again, friction decreases with the increase of velocity, and it increases with the diminution of velocity. This is well known to us all who "eat our bread by the sweat of the brow;" for, if we start a loaded carriage, or a mill wheel, a greater power is required to overcome the *inertia*,* than to continue motion afterwards. This proves that the increase of velocity decreases the power of friction: But to calculate the proportions of the decrease of friction in this case, would require as many statements as there are seconds or half seconds in the time from the starting of the wheel, till it is moved with its highest degree of velocity.

---

* Velocity, swiftness of motion.

† This principle is asserted by writers on friction, but how they will dispose of attraction by cohesion, when two surfaces are put in contact, I cannot imagine, unless by oiling the parts before they are placed together. This may destroy attractive cohesion.

Respecting these principles of friction, Mr. Evans of Philadelphia, the noted millwright, has made the following experiments. He placed a flat-sided glass bottle on an oiled steel plate; and when the bottle was loaded with 10 pounds, it was drawn by a power of 1 pound—when loaded with 22 pounds, it was drawn by 2 pounds; and when loaded with 60 pounds, it was drawn by 4½ pounds.

In this last trial of 60 pounds drawn by 4½ pounds, he says the motion was greatly accelerated, which gives reason to conclude that, less weight would have continued the motion after once begun. He then goes on partly by guess, and partly by calculation, to prove the above theory and establish some partial rules: that is to say,

If 10 pounds are moved by 1 pound, then so small a body possesses a resisting power of $\frac{1}{10}$ part of the whole—22 pounds being moved by 2 pounds, the resisting power was $\frac{1}{11}$ of the whole; and 60 pounds being moved by 4½ pounds, the power of resistance by friction appeared to be about $\frac{1}{13}$ of the whole. Then he argues, if this small body of 60 pounds, possesses a resisting power of only $\frac{1}{13}$ part of the whole, then a large body, such as a mill wheel of 4000 pounds weight, will possess not more than $\frac{1}{20}$, and at the same time the gudgeons shall be equal in diameter with the wheel, in order to coincide with the principle of plain surfaces rubbing together like the bottle and the steel plate. He then gives the following

---

* Inertia, a power in matter which disposes it to continue in the same state; inactivity, sluggishness.

RULE.

As the diameter of the wheel,
is to the diameter of the gudgeons;
So is one twentieth part of the weight of the wheel,
to the weight which will balance the friction.

Then follows an example which we will take for

LESSON 1.

If a mill wheel weighing 4000 pounds be 15 feet in diameter, and the gudgeons 3 inches in diameter, how many pounds on the rim of the wheel will balance the friction?

Ans. 3.333 pounds.

Operation.

```
2|0)400|0 pounds the weight of the wheel.
     200 a twentieth part.
15 feet × 12 = 180 In.
     Diam. wheel. Gud. lb.
               180 : 3 :: 200 to a fourth number.
                           3
                         ———
                    180)600(3.3+ pounds.
                        540
                        ———
                        .600*
                         540
                         ———
```

We will try one lesson more and quit the subject.

LESSON 2.

If the diameter of a wheel be 18 feet, the weight 3600 pounds, and the gudgeons 3 inches in diameter, how many pounds on the rim of the wheel will balance the friction?

Ans. 2.5 pounds.

3600 ÷ 20 = 180 a twentieth part of the weight of the wheel. 18 feet × 12 = 216 inches the diameter of the wheel.

W. G. lb.
216 : 3 :: 180
3

216)540(2.5 pounds.
432

1080*
1080

EXERCISING QUESTIONS.

LESSON 1.

In £ 346, how many shillings, sixpences, threepences and farthings? Answer, 6920*s.* 13840 sixpences, and 332160 farthings. Root, p. 50.

2. Reduce 27680 threepences into pounds.
Make it £ 346. Root, p. 50.

3. In £ 386, how many shillings, ninepences, sixpences, fourpences and pence, and of each an equal number?
12*d.* + 9*d.* + 6*d.* + 4*d.* + 1*d.* = 32*d.* for a divisor. £ 386 = 92640*d.* ÷ 32 = 2895 the answer. Root, p. 50.

4. In 49 bushels how many quarts?
49 × 32 = 1568 the answer. Root, p. 51.

5. Two men were shoveling a cargo of salt out of a vessel, and it was judged that each man threw out six quarts at a time, and the cargo contained one thousand bushels—I demand the number of shovel-fulls for each man to throw out? Ans. 2666⅔. Root p. 52.

6. How many days will a barrel of cider last if you draw six quarts a day, allowing the barrel to hold 31½ gallons?
Ans. 21 days. Root p. 52.

7. How many apples will it take to make a load or ton of cider, allowing 3 apples to make a gill, and 252 gallons a ton? Ans. 24192 apples. Root, p. 52.

8. How many times will a carriage wheel, 15¼ feet in circumference, turn round in going from New-York to Philadelphia, it being 95 miles?

Ans. 32713 times and 8 in. over. Root, p. 52.

9. The forward wheels of a waggon are 14¼ feet in circumference, and the hind wheels 15 feet 9 inches; how many more times will the forward wheels turn round than the hind wheels, in running from Boston to New-York—it being 248 miles? Ans. 7167 Root p. 52

10. In a room 16 feet square; how many square feet?

Ans. 256. Root, p. 53.

11. How many shingles will cover a house 40 feet long and 30 feet rafters, allowing shingles to be 4 inches wide, and each course 6 inches? Ans. 14400 Root, p. 53.

Note.—We may add 240 shingles to form a double course over the eaves.

12. In a field 60 rods square, how many acres?

Ans. 22½ acres. Root, p. 53.

13. How much carpeting 3 qrs. wide will cover a floor 18 feet long and 16 feet wide?

Ans. 42 yds. 2 qrs. 6 inches. Root, p. 53.

PROOF OF THE LAST QUESTION.

14. How many square inches in a piece of carpeting 42 yds. 2 qrs. 6 inches long, and 27 inches wide?

Ans. 1536 inches.

15. How many seconds from the birth of Christ to Christmas 1795, allowing each year to contain 365 days 6 hours?

Ans. 56,645,892,000. Root, p. 54.

16. Sound goes 1142 feet in a second: suppose in a thunder storm you see the lightning 24 seconds before you hear the thunder; at what distance are you from the explosion?

Ans. 5 miles, 1 fur. 21 yds. 1 ft. 6 in. Root, p. 55.

17. The inhabitants of the whole world are computed to be 953 millions; supposing they all stood in a line, how long would it take you to count them all, if you could count

20 in a minute and continue counting 12 hours in a day? Ans. 181 yrs. 115 days, 6 hrs. 40 min. Root, p. 55.

18. How many pounds of sugar can you buy for £11 11*s.* at 4½*d.* a pound? Ans. 5 cwt. 2 qrs. Root, p. 66.

19. What cost 17 cwt. 3 qrs. 14 lb. at 5 cents a pound?
Ans. $ 100, 10 cents. Root, p. 66.

20. If 5 tons of hay will keep 3 cattle over the winter, how many tons will it take to keep 37 cattle the same time?
Ans. 61 tons, 13 cwt. 1 qr. 9⅓ lb. Root, p. 66.

21. A gentleman farmer had 21 bushels Indian corn which he wished to mix with buckwheat so that every bushel of provender should contain 13 quarts of Indian corn; I demand the quantity of buckwheat in the mixture?
Ans. 30 bush. 2 pecks, $6\frac{2}{13}$ qts. Root, p. 66.

Say, as 13 qts. of corn : are to 19 qts. of buckwheat :: so are 21 bush. corn or 672 qts. : to 30 bush. 2 pecks, $6\frac{2}{13}$ qts. buckwheat.

22. Seventy-five pounds sterling of Great Britain are equal to £100 New-England currency; how much New-England currency is £410 19*s.* 2*d.* sterling money of Great Britain? Ans. £547 18*s.* 10½*d.* Root, p. 66.

23. When a staff 3 feet long will cast a shade 2½ feet, what is the height of a steeple that casts a shade 107 feet at the same time of the day?
Ans. 128⅖ feet. Root, p. 67.

24. A Merchant agreed with his debtor that if he would pay him down 12*s.* 6*d.* on the pound, he would give him up a note of hand of £69 5*s.* 4*d.*; I demand what the debtor must pay for the note? Ans. £43 5*s.* 10*d.* Root, p. 67.

25. Two boys are playing tag, one boy has 6 rods the start, but the other boy can run 15 to his 13; I demand how far the hindermost boy must run before he will overtake the other one? Ans. 45 rods. Root, p. 67.

State thus: If 2 rods deficiency : arise in 15 :: what will 6 rods deficiency arise from? 2 : 15 :: 6 : 45

26. Suppose stock in the United States Bank to be 15

per cent. above par, that is, every 100 dollars worth $115; I demand what 3 shares are worth at 400 dollars each?

Answer, 1380 dollars. *Root, p.* 67.

27. Sold a vessel for 2500 dollars, and I owned $\frac{5}{16}$; what was my part of the money? Ans. $ 781 25 cts. *Root, p.* 68.

28. A merchant in Connecticut paid a merchant in England, £4349 16*s.* 4*d.* in dollars at 4*s.* 6*d.* each; how much was that value in New-England currency of 6*s.* to the dollar? Ans. £5799 15*s.* $1\frac{1}{3}$*d.* *Root, p.* 68.

29. A gentleman sent a ship on a whaling voyage, and agreed to divide the proceeds of the voyage into 60 shares and give the captain 4; the ship afterwards returned with a cargo worth ten thousand dollars—I demand the captain's part? Ans. $666 $66\frac{2}{3}$ cts. *Root, p.* 68.

30. A bankrupt owes £1490 5*s.* 10*d.* but the whole of his estate is worth no more than £931 8*s.* $7\frac{3}{4}$*d.*—I demand how much he can pay his creditors on the pound?

Ans. 12*s.* 6*d.* *Root, p.* 68.

31. What is the price of a ship when $\frac{5}{8}$ of her are worth $$1765\frac{1}{4}$? Ans. $2824 40 cts. *Root, p.* 68.

N. B. As $\frac{5}{8}$ are to 1765.25 :: so are $\frac{8}{8}$ to 2824.40.

32. Suppose you have 476 dollars 37 cents of deferred stock, and every dollar is worth 65 cents; how much is the whole worth? Ans. $309 64 cts. *Root, p.* 68.

33. If 7 buttons cost $2\frac{1}{2}$*d.*, what for a great gross, or 1728?

. Ans. £2 11*s.* $5\frac{4}{7}$*d.*

34. Suppose a legislature of a state grant a tax of $1\frac{1}{2}$*d.* on the pound; how much must a man pay who is rated £134 16*s.* 8*d.* on the list? Ans. 16*s.* $10\frac{1}{4}$*d.* *Root, p.* 69.

See Part 9, *p.* 273.

240*d.* : 6*q.* :: 1*d.* : .025*q.* common multiplier.

35. Harry had pears, 9 of which were worth 6*d.*, Billy had apples, 8 of which were worth 2*d.*—I demand what number of apples Billy must give Harry for 15 of his pears?

Ans. 40. *Root, p.* 69.

1st. as 9 P. : 6*d.* :: 15 P. : 10*d.*
2d. as 2*d.* : 8 A. :: 10*d.* : 40 Ap.

36. A can do a job of work in 10 days, B can do the same in 15 days; how long will it take both together to do the same work? Ans. $6\frac{1}{4}$ days.

A 10 days.
B 15

Make $25 \div 2 = 12.5$ that is, at the rate of $12\frac{1}{2}$ days for one man.' Then,

As 1 man : is to 12.5 days : : 2 men : 6.25 days inversely.

37. If 100 dollars gain 6 dollars in 12 months, what principle will give the same in 5 months? Ans. $240. *Root*, *p*. 70.

As 12 mo. : $100 : : 5 mo. : 240 inversely.

38. What will be the price of 72 yards of cambrick, of which 9 yards cost £5 12*s*.? Ans. £44 16*s*. *Hutton*, *p*. 38.

yds. £. *s*. yds. £. *s*.
9 : 5 12 : : 72 : 44 16

Multiply the second term by 8, the product will be the answer; because any number multiplied by 8, will produce the same result as if it were multiplied by 72, and that product divided by 9.

39. What will 9 yards of cambrick cost at the rate of £44 16*s*. for 72 yards? Ans. £5 12*s*. *Hutton*, *p*. 38.

Divide the second term by 8, the quotient will be the answer. 72 yds. : £44 16*s*. : : 9 yds. : £5 12*s*.

40. How many men must be employed to finish a piece of work in 15 days, which 5 men can do in 24 days?

Ans. 8 men. *Hutton*, *p*. 38.

Examine Mr. Hutton's Arithmetic, page 36.

41. A garrison being besieged, has 5 months' provision in it, at the rate of 12 ounces a day for each man; but being informed that it cannot be relieved till after 9 months, how much per day must each man have that the provisions may last that time? Ans. $6\frac{2}{3}$ oz. *Hutton*, *p*. 39.

42. What will the tax be on £763 15*s*., at the rate of 3*s*. 6*d*. per pound? Ans. £133 13*s*. $1\frac{1}{2}$*d*. *Hutton*, *p*. 39.

43. What will 7 cwt. 1 qr. of sugar cost, at the rate of 43 cwt. 2 qrs. for £159 2*s.*? Ans. £26 10*s.* 4*d.* *Hutton, p.* 39.

44. A person stopping payment, owes to several £977, but compounds with them for 8*s.* 7¼*d.* per pound; what must he pay them in all? Ans. £420 6*s.* 3¼*d.* *Hutton, p.* 39.

45. What must be given for 7 cwt. 3 qrs. 14 lb. cheese, at £1 14*s.* 2*d.* per cwt.? Ans. £13 9*s.* 0¾*d.* *Hutton, p.* 39.

46. If the tax on £763 15*s.* be £133 13*s.* 1½*d.*, at what rate is it per pound? Ans. 3*s.* 6*d.* *Hutton, p.* 48.

47. What will the transportation of 8 cwt. 3 qrs. 7 lb. cost, at the rate of 10*d.* per stone of 14 lb.?
Ans. £2 18*s.* 9*d.* *Hutton, p.* 40.

48. What must be paid for 73 pieces of lead, each weighing 1 cwt. 3 qrs. 7 lb., at £10 4*s.* per fother of 19½ cwt.?
Ans. £69 4*s.* 2*d.* $1\frac{18}{78}$*q.* *Hutton, p.* 40.

49. If 5 yards of cloth cost 14*s.* 2*d.*, what must be given for 9 pieces containing each 21 yds. 1 qr.?
Ans. £27 1*s.* 10½*d.* *Hutton, p.* 40.

50. A person, at the time of his outsetting in trade, owed £350; and had in cash £5307, in wares £713 0*s.* 7*d.*, and in good debts £210 5*s.* 10*d.*: now, after having traded a year, he owed £703 17*s.*, and had in cash £4874 9*s.* 4*d.*, in bills £350, in wares £1075 14*s.* 3¼*d.*, and in recoverable debts £613 13*s.* 10½*d.*; what was his real gain that year?
Ans. £329 4*s.* 1*d.* *Hutton, p.* 137.

51. If a hopper be 42 inches square on the top, and 24 inches deep, how much will it hold? Ans. 6.5625 bushels.
Evans' Millwright and Miller's Guide, Chap. 2, *p.* 47.

RULE.

Multiply the length by the width at top, and that product by one third of the depth, divide the last product by 2150.4, if you calculate by inches, or by 1.24444 if you work by feet; the quotient will be the contents in bushels

To make a Hopper to hold any given quantity, having the depth given.

RULE.

Divide the inches contained in the bushels it is to hold, by one third of the depth in inches; the quotient will be the square of one of the sides at top. Extract the root of that square for the length of one side.

EXAMPLE.

52. The hopper shall hold 6.5625 bushels, the given depth is 24 inches, how long must be one side at top?

Ans. 42 inches. *Evans, p.* 48.

OPERATION.

The number of bushels in the hopper,	6.5625
The number of inches in a bushel,	2150.4
	262500
	3281250
	65625
	131250
One third the depth ÷	8)14112.00000
	√1764.(42 Ans. in inches.
	16
	82).164
	164
	...

OF A GARNER OR BIN.

On the 5th of March, 1816, an old jockey bet that a bin 3.5 feet square and 3 feet high would hold 30 bushels; a young industrious man bet it would not hold so much: after calculating the contents, the jockey refused to pay the bet because he could pile on 30 bushels: pray how much did the bin hold without any prevarication?

Answer, 29 bush. 16 qts. 7.9+ gills.

One bushel = 1.24444 foot for a divisor.

One side of the bin 3.5 feet × 3.5 = 12.25 × 3 the height = 36.75 feet for a dividend.

1.24444)36.75000(29.531 B.
248888
———
1186120
1119996
———
..661240*
622220
———
.390200*
373332
———
.168680*
124444
———
.44236

B 29.531
32 qts. in a bush.
———
1062
1593
———
qts. 16.992
8 gills in a qt.
———
gills 7.936

To make a Garner, Bin, or Box, that shall hold any given quantity, having two of its sides given, take the following

RULE.

Multiply the contents of one bushel by the number of bushels the bin is to hold, for a dividend; then multiply the given sides into each other for a divisor, the quotient will be the length of the side wanting.

EXAMPLE.

53. Given, two sides of a garner 6.25 by 10.5 feet; required, the other side, to hold 184.6 bushels. Evans, p. 47.

EXPLANATION.

One side 6.25 × 10.5 = 65.625 for a divisor; 1.24444 the contents of a bushel × 184.6 the quantity in bushels = 229.723624 ÷ 65.625 = 3.5 feet for the side required.

54. A distribution of £45 16*s.* is to be made between three persons in the following manner, viz: When the first has 40*s.* the second shall have 30*s.* and the third 10*s.*; what sum is each one's part in the whole?

Answer, the first 458*s*., the second 343*s*. 6*d*., the third 114*s*. 6*d*.

£45 16
20

The given sum 916 shillings.
40*s*. the proportion of the first.
30*s*. of the second
10*s*. of the third.

80*s*. amount of the proportions.

Rule for the operation.

Multiply the given sum by each one's proportion, and divide the product by the amount of proportions; the quotients will be the answers.

916*s*.
40*s*. first proportion.

8|0)3664|0
458*s*. for the first.

916*s*.
30*s*. 2nd. proportion.

8|0)2748|0
343*s*. 40*s*. over.
12

8|0)48|0
6*d*.
343*s*. 6*d*. the second's part.

8|0)916|0* the third cast.
114*s*. 40 over.
12

8|0)48|0
6*d*.

Proof.

1st. 458*s*.
2d. 343*s*. 6*d*.
3d. 114*s*. 6*d*.

916*s*. 0*d*.

* A cipher annexed to multiply by 10.

A SECRET FOR TEACHERS.

How to know with one glance of the eye, the true amount of any sum in Addition.

The Teacher will set the sums himself in *couplets* after the following manner.†

---

† But at the same time he need not make the same distinctions, with braces because a designing roguish lad may discover the mystery and learn lazy boys to cheat.

4562	First couplet.
5437	
1234	Second couplet.
8765	
4567	Third couplet.
5432	
1463	A half couplet.
31460	Amount.

In the first place observe, that when the members of each couplet are added together, their amount will make 9999, then observe how many couplets there are; in this case say 3; subtract 3 from the right hand figure in the half couplet, and at the same instant place 3 on the left of the whole, and bring down the residue of the said half couplet, viz. 1, 4, 6; then the amount will stand thus, 31460. This rule will hold good in all the various denominations; as, pounds, shillings, pence, farthings; hundreds, quarters, pounds, ounces, &c.: Only observe, that, *each couplet contains one less than the number in that denomination:* That is to say, in whole numbers, 9; in shillings, 19; in pence, 11; in farthings, 3;—For Avoirdupoise weight, in quarters 3; in pounds, 27; in ounces, 15; in drams, 15, &c. &c.

EXAMPLE.

£44	16	8	2	First couplet.
55	3	3	1	
14	14	5	3	Second couplet.
85	5	6	0	
41	15	5	3	A* half couplet.
£241	15	5	1	

In this last example we say, there are 2 couplets; and the right hand figure is 3; then 2 from 3 and 1 remains; set the 1 under 3 and carry 2 to the left of the whole: bring down the residue of the half couplet, and the amount will stand thus; £241 15*s.* 5*d.* 1*q.*

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* The Teacher will please to recollect that when, h, is sounded at the beginning of a word, we improperly place, an, before it.

APPENDIX,

CONTAINING,

SOME SKETCHES OF BOOK-KEEPING, RECEIPTS, BILLS, &c.

BOOK-KEEPING

Is a critical and curious art by itself; and ought to be studied as a distinct science and separately from all other professional employments: Then, through the occurrences of life, it may be blended with any business which shall require its aid.

As many country merchants, tradesmen, mechanics, and farmers, have not an opportunity to learn book-keeping in a full and formal manner, it may not be amiss to insert a few sketches applicable to their business. But, when a young man means to be an accomplished accountant, he must have recourse to some instructer who is able to teach him the art of keeping accounts in all the various useful forms.* Then will be a proper time to study Walsh's arithmetic, especially when learning lessons relative to shipping business.

Description and form of a set of books, for a country merchant, or for a mechanic who has occasion to make many entries in a day.

First, let him have an Invoice book, in which if he please, he may enter an inventory of his estate; and afterwards enter or copy bills of goods and the names of the persons from whom purchases are made, the time when interest commences, when payable, &c.

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* Mr. Bennet of Albany has lately written a manuscript on book-keeping, which is extolled by a great number of gentlemen in the mercantile line, who may be considered as competent judges. Subscriptions have been offered to the public, and it is hoped that success will soon warrant a publication.

Second, prepare a Blotter, in which may be inserted all commercial business occurring throughout the day. This may be written in form of a Day-book, but more expeditiously.

Third, where Potash is manufactured let there be an Ash-book, in which set the day of the month, the names of persons delivering ashes, and the number of bushels delivered: also credit those ashes to the respective owners in the blotter.

Fourth, procure a Day-book, and transcribe the Blotter every night into the Day-book in a neat fair hand writing; or, where considerable business is done, let the Blotter be made in daily parts, and given over to a clerk for transcription and to be attached to the former ones.—Save these blotters for an evidence of the first entries in case of dispute.

Fifth, have a Ledger, into which must be posted all accounts of debt and credit on such pages as are noted in the alphabet; and the figures of reference in the margin of the Day-book must be post-marked with a double inclining dash. A cash account may be in the Ledger.

Sixth, a Receipt-book, in which take receipts for all money paid out; this will save much time in thumbing over bundles of papers.

DAY-BOOK A.

THE PROPERTY OF

GIDEON WEALTHY.

DAY-BOOK A, PAGE 1.

Ledg. No. 1.

page	*January* 1, 1816.		
1	JOHN TRADEWELL, of Albany, Dr.	$	cts.
	To joiner work 1 day by my apprentice Ralph,	1	50
//	To 10 pine boards, 14 feet each, 140 feet, at $12 per M.	1	68
		3	18
	Cr.		
	By 100 gal. Rum, at 125 cents,	125	00
1	36 yds. Broadcloth, 400	144	00
	19 bush. Salt, 112½	21	37½
//	36 gal. Molasses, 75	27	00
	Payable in 90 days, without interest,		
	See Invoice Book No. 1, page 1.	317	37½
	2		
1	JOHN TRADEWELL, Dr.		
//	To 2 days of joiner work, by Ralph and James,	3	00
	3		
	PETER PAYMENT, of Bern, Dr.		
1	To 5 gal. Rum, at 150 cents,	7	50
	1 bush. Salt,	1	25
//	2 gal. Molasses, 100	2	00
	2½ yds. Broadcloth, 450	9	00
		19	75
	Cr.		
1	By Cash, $12 50		
	By his Note on demand for 7 25		
//		19	75
	4		
	AMOS LOOKOUT, Dr.		
1	To 4 gal. Molasses, at 100 cents,	4	00
	2 bush. Salt, 125	2	50
//		6	50
	4		
1	JOHN TRADEWELL, Dr.		
//	To 2 days joinering, by Ralph,	3	00
	5		
	SIMON HOPEWELL, Dr.		
1	To 4 yds. Broadcloth, at 450 cents,	18	00
	6 gal. Rum, 150	9	00
//	3 bush. Salt, 125	3	75
		30	75
	6		
	JACOB HALEON, Dr.		
1	To 4 yds. Broadcloth, at 450 cents,	18	00
	2 bush. Salt, 125	2	50
//	2 gal. Molasses, 100	2	00
		22	50

DAY-BOOK A, PAGE 2.

Ledg. No. 1.

page	*January* 6, 1816.	$	cts.
1	JOHN TRADEWELL, Dr.		
//	To 150 feet pine boards, at $12 per M.	1	80
	8		
1	PETER PAYMENT, Dr.		
//	To his Note of 3d instant, given up,	7	25
1	Cr.		
//	By Cash, $7 25		
	8		
1	SILAS ANDOVER, Dr.		
//	To 1 gal. Rum,	1	50
1	Cr.		
//	By 2 bush. Corn, at 75 cents,	1	50
	8		
1	ISAAC HEARTY, Dr.		
//	To 3 gal. Molasses, at 100 cents,	3	00
1	Cr.		
//	By ½ bush. Rye,		50
	9		
1	JOHN TRADEWELL, Dr.		
//	To Cash, as per receipt,	55	00
	9		
1	AMOS LOOKOUT, Dr.		
//	To 2 yds. Broadcloth, at 450 cents,	9	00
1	Cr.		
//	By his Note, payable in 30 days, $15 50		
	9		
1	SIMON HOPEWELL, Dr.		
//	To 1 bush. Salt,	1	25
1	Cr.		
//	By his Note on demand, for	32	00
	10		
1	JACOB HALEON, Dr.		
//	To 1¼ yd. Broadcloth, at 450 cents,	6	75
	Cr.		
1	By Cash, $5 00		
//	his Note on demand, for 24 25		
		29	25
	11		
	PETER PAYMENT, Dr.		
1	To 4 gal. Molasses, at 100 cents,	4	00
//	1 bush. Salt,	1	25
		5	25
1	Cr.		
//	By a negotiable Note on J. G. for $5 25		

DAY-BOOK A, PAGE 3.

Ledg. No 1.

page		$	cts.
	January 11, 1816.		
	JOHN TRADEWELL, Dr.		
1	To Cash, as per receipt,	44	68
	14 lb. 10d. Nails, at 12 cents,	1	68
//			
		46	36
	— 12 —		
1	SILAS ANDOVER, Dr.		
	To 1 barrel Rum, containing 31½ gals., at 150 cents,	47	25
//	9 bush. Salt, 125	11	25
		58	50
	Cr.		
1	By abatement on the above, $1 46		
	Cash, 33 50		
//	his note of hand, for 22 04	57	00
	— 13 —		
1	ISAAC HEARTY, Dr.		
//	To 15 gals. Rum, at 150 cents,	22	50
	Cr.		
1	By Cash, $15 00		
//	his Note at 30 days, 10 00	25	00
	— 13 —		
	JOHN TRADEWELL, Dr.		
1	To Cash, as per receipt,	75	00
	— 15 —		
//	To 34 panes of Glass, at 9 cents,	3	06
		78	06

LEDGER No. 1.

THE PROPERTY OF

GIDEON WEALTHY.

LEDGER No. 1, Page 1.

D. Book A. Page			D. Book A.	$	Cts.
	JOHN TRADEWELL,	**Dr.**			
1	Sundries, $3.18	Work, $3.00	1	6	18
1	Work, 3.00	Boards, 1.80	2	4	80
2	Cash, 55.00	Sundries, 46.36	3	101	36
3	Cash, 75.00	Glass, 3.06	3	78	06
	January 15th, 1816.			190	40
	To my note at 75 days for			126	97½
	Balanced 15th January, 1816.			317	37½
	PETER PAYMENT,	**Dr.**			
1	Sundries, $19.75	Note, $7.25	2	27	00
2	Sundries, 5.25			5	25
	Balanced, 11th January, 1816.			32	25
	AMOS LOOKOUT,	**Dr.**			
1	Sundries, $6.50	Broadcloth, $9.00	2	15	50
	SIMON HOPEWELL,	**Dr.**			
1	Sundries, $30.75	Salt, $1.25	2	32	00
	JACOB HALEON,	**Dr.**			
1	Sundries, $22.50	Broadcloth, $6.75	2	29	25
	January 15th, 1816.	To your Note given up.		24	25
				53	50
	SILAS ANDOVER,	**Dr.**			
2	Rum, $1.50	Sundries, $58.50	3	60	00
	Balanced 14th January, 1816.			60	00
	ISAAC HEARTY,	**Dr.**			
2	Molasses, $3.00	Rum, $22.50	3	25	50

LEDGER No. 1, Page 1.

D. Book A. Page			D. Book A. Page	$	Cts.
	JOHN TRADEWELL, Cr.				
1	Sundries, $317.37½			317	37½
	January 15th, 1816. Balanced by note.			317	37½
	PETER PAYMENT,	**Cr.**			
1	Sundries, $19.75	Cash, $7.25	2	27	00
2	Note, 5.25			5	25
	Balanced 11th January, 1816.			32	25
	AMOS LOOKOUT,	**Cr.**			
2	Note payable at 30 days,			15	50
	SIMON HOPEWELL,	**Cr.**			
2	Note on demand,			32	00
	JACOB HALEON,	**Cr.**			
2	Note, $24.25	Cash, $5.00	2	29	25
	January 15th, 1816.	By Cash for Note,		[illegible]	25
				53	50
	SILAS ANDOVER,	**Cr.**			
2	Corn, $1.50	Sundries, $57.00	3	58	50
	January 14th, 1816.	By Cash in full.		1	50
				60	00
	ISAAC HEARTY,	**Cr.**			
2	Rye, $0.50	Sundries, $25.00	3	25	50

A FARMER's ACCOUNT.

A mechanic who can attend to enter all his charges without being hurried, may omit the blot-book, and make his original entries in the day-book; or he may keep his accounts in the following manner with a ledger only.

A. D. 1816.	GEORGE REYNOLDS, Dr.	$	Cts.
January			
1	To 3 bushels Rye, at 106 cents,	3	18
5	To 5 lb. Butter, 15		75
8	To 1 pair men's Shoes,	1	75
	1 pair women's do.	1	50
12	To 23 lb. Soleleather, at 25	5	75
February 6	To 7 bushels Indian corn, 75	5	25
8	To 1 Ploughshare-mould, wt. 56 lb.	4	48
10	To an old ox-yoke and irons per agreement in presence of A. B. C.	3	12½
12	To 1 wax Calfskin for your boots,	2	75
14	To 19 lb. Mutton, at 5 cents,		95
15	To my paying the post for your newspapers, as per receipt,	1	00
		30	48½

A FARMER's ACCOUNT.

A. D. 1816.	GEORGE REYNOLDS, Cr.	$	Cts.
January			
1	By yourself and oxen 1 day,	1	25
3	By 4 cords of Wood at 175 cents,	7	00
5	By transporting a load of Boards to Albany, per agreement,	3	00
8	By 1 barrel Cider,	4	00
10	By 1 hive of Bees,	5	37½
		20	62½
	January 15th, by a Note,	9	86
	Balanced 15th January, 1816.	30	48½

INVOICE BOOK No. 1. Page 1.

No. 1. An Inventory of the Estate of Gideon Wealthy, taken at Albany, January 1, 1816.

	$	cents
1 Yoke of Oxen valued at - - -	75	00
1 House, Lot No. —— in —— Street, - -	1200	00
Cash, - - - - - -	500	00
	1775	00

No. 2. COPY OF JOHN TRADEWELL's BILL.

Mr. Gideon Wealthy,

Bought of John Tradewell, January 1, 1816.

			$	cents
100 Gal. Rum,	at	125 cents, - -	125	00
36 Yds. Broadcloth,		400 - -	144	00
19 Bush. Salt,		112½ - - -	21	37½
36 Gal. Molasses,		75 - - -	27	00
			317	37½

Payable in 90 days without Interest.

See Day-book A. Page 1.

No. 3. COPY OF ELISHA SHINGLEMERCHANT's BILL.

Mr. Gideon Wealthy,

Bought of Elisha Shinglemerchant,

Albany, [illegible]

1000 feet of Pine Boards,	$ 10	50

Payable on demand.

No. 4. COPY OF ELI GLAZI[illegible] BILL,

Mr. Gideon Wealthy,

Bought of E[illegible] 1, 1816.

100 feet of 9 by 7 Glass,	$ 15	[illegible]

Payable in 60 days.

No. 5. COPY OF JOB NAILER's BILL.

Mr. Gideon Wealthy,

Bought of Job Nailer, January 1, 1816.

100 wt. Nails, at 11 cents per lb.	$ 11	00

Payable on demand.

No. 6. Bought of Philip Oysterman, January 4, 1816.

5000 Oysters, at 50 cents per 100,	$ 25	00

Paid Cash in full as per Receipt on Bill No. 6.

INVOICE BOOK No. 1. Page 2.

No. 7. COPY OF THO. DRYGOODS' BILL.

Mr. Gideon Wealthy,

Bought of Tho. Drygoods, January 4th, 1816.

			$	Cents.
17½ Yards of Broadcloth,	at	550 cents.		
[illegible] Yards of Satinet,		250		
7 Yards of doublemilled Drab,		400		
30 Yards of shalloon,		30		
14 Yards of Serge,		200		
27 Yards of Factory Blanketing,		150		
[illegible]6 Yards of Factory Coating,		125		
		$		

No. 8. COPY OF IRA GROCER's BILL.

Mr. Gideon Wealthy,

Bought of Ira Grocer, January 4, 1816.

			$	Cents.
5 lb. Green Tea,	at	175 cents.		
10 lb. Bohea,		100		
9 lb. Hyson Skin,		125		
4 lb. Pepper,		50		
3 lb. Pimenta,		40		
2 lb. Ging[illegible],		14		
		$		

RECEIPT BOOK, No. 1, PAGE 1.

No. 1. **A GENERAL DISCHARGE.**

Received, Albany, 4th January, 1816, of Thomas Silverton, thirty dollars and fifteen cents, in full of all my demands against him of whatever name or nature.

ANTHONY DISCOUNT.

No. 2. **A DISCHARGE ON ACCOUNTS.**

Received, New-York, 4th January, 1816, of Erastus Lont, his note for nine dollars and forty-five cents; which, when paid, will be in full of book accounts.

Received by me, JASON GEORGE.

No. 3, p. 2. **FOR RENT.**

Received, Albany, 4th January, 1816, of Thurs[illegible]well and James Industry, twenty-two and a half bushels of wheat, in full for rent and all arrearages on Lot No. 204, up to the 2d instant.

Received for S. V. RENSSELAER.
A. B. C. Agent.

No. 4, p. 3. **FOR RENT IN A CITY.**

Received, New-York, 3d February, 1816, of K. B. one hundred dollars, in full for the last quarter's rent, due the first instant, of the messuage and tenements he now occupies, situ[illegible]

No. 5, p. 4. **ON A MORTGAGE.**

Received, Westerlo, 5th February, 1816, of G. B. one hundred [illegible] dollars, agreed to be in full for principal and interest of the third payment mentioned in a bond and mortgage I hold against him, of Lot number [illegible] situate in the town of Freehold, and county of Greene.

Received by me, [illegible] R. H.

No. 6, p. 5. **RECEIVED FOR ANOTHER PERSON.**

Received, Bern, 5th February, 1816, of P. R. sixty dollars, to deliver to G. A. Worth, cashier of the Mechanics' and Farmers' Bank, at Albany, and am to take his receipt for the same.

Received by me, Z. W.

RECEIPT BOOK, No. 1, PAGE 2.

When these monies are entered on the Day-Book, always enter the number of the Receipt, and page of the Receipt-Book; thus,

New-York, 3d February, 1816.

R. S. Dr.

To Cash in full for rent, up to the first instant,	$100 00
Receipt-Book, No. 1, Rec't No. 4, p. 3.	

Thus receipt can always be found readily, when a dispute arises.

A NOTE.

Six months after date, I promise to pay George W. or bearer, fifteen dollars and sixty cents, with interest, for value received. Westerlo, 6th March, 1816.

L. M. P.

ANOTHER.

For value received, we promise to pay K. P. ninety dollars, on the 24th day of December next, with interest. Witness our hands at Westerlo, 6th of March, 1816.

W. B.
Y. R.

INTRODUCTION TO ARITHMETIC,

PART XIII.

CONTAINING

CARDS FROM No. 6 TO No. 32, INCLUSIVELY.

Simple Addition.

Lesson 1. Page 69.	*2nd.* Page 69.	*3rd.* Page 70.
22 Apples	34 Peaches	152 Pears
34	41	343
21	52	444
33	35	561
12	24	324
23	34	444

Lesson 4th. Page 70.	*5th.* Page 71.	*6th.* Page 71.
461	564	1562
352	456	2446
433	352	3125
502	463	4563
434	624	2344
346	102	4653

Lesson 7th. Page 72.	*8th.* Page 72.	*9th.* Page 73.
3470	6410	7420
2665	7520	302
4670	4060	5008
3760	5007	701
0040	7010	4500
4000	2200	3300

Simple Subtraction.

Lesson 1*st.*	2*nd.*	3*rd.*
Page 73.	Page 74.	Page 74.
2468	45621	582137
1345	35242	216232
Lesson 4*th.*	5*th.*	6*th.*
Page 75.	Page 75.	Page 75.
456821	601021	821903
324912	8970	12461
Lesson 7*th.*	8*th.*	9*th.*
Page 76.	Page 76.	Page 77.
781210	641315	456781
521621	426436	326879
Lesson 10*th.*	11*th.*	12*th.*
Page 77.	Page 78.	Page 79.
642137	460210	900000
472318	340012	426436
Lesson 13*th.*	14*th.*	15*th.*
Page 79.	Page 80.	Page 80.
54321	628134	644310
18765	419243	421536

Numeration Table.

See page 90.

Units;

Units, tens;

Units, tens, hundreds;

Units, tens, hundreds, thousands;

Units, tens, hundreds, thousands, tens of thousands;

Units, tens, hundreds, thousands, tens of thousands, hundreds of thousands;

Units, tens, hundreds, thousands, tens of thousands, 100 of thousands, millions;

Units, tens, hundreds, thousands, tens of thousands, 100 of thousands, millions, tens of millions;

Units, tens, hundreds, thousands, tens of thousands, hundreds of thousands, millions, tens of millions, hundreds of millions;

Numeration Table.

See page 80.

One :	**1.**
Twelve :	**12.**
One hundred and twenty-three :	**123.**
One thousand, 234 :	**1,234.**
Twelve thousand, 345 :	**12,345.**
123 thousand, 456 :	**,123,456.**
One million, 234 thousand, 567 :	**1,234,567.**
Twelve million, 345 thousand, six hundred and 78 ;	**12,345,678.**
One hundred and 23 million, 456 thousand, 789 :	**,123,456,789.**

400 CARD No. 8.

Multiplication Table.

2

Twice	1	make	2
twice	2		4
twice	3		6
twice	4		8
twice	5		10
twice	6		12
twice	7		14
twice	8		16
twice	9		18
twice	10		20
twice	11		22
twice	12		24

3

Three	1	make	3
three	2		6
three	3		9
three	4		12
three	5	make	15
three	6		18
three	7		21
three	8		24
three	9		27
three	10		30
three	11		33
three	12		36

4

Four	1	make	4
four	2		8
four	3		12
four	4		16
four	5		20
four	6		24
four	7		28
four	8		32

Multiplication Table.

	4				6		
four	9	make	36	Six	1	make	6
four	10		40	six	2		12
four	11		44	six	3		18
four	12		48	six	4		24
	5			six	5		30
Five	1	make	5	six	6		36
five	2		10	six	7		42
five	3		15	six	8		48
five	4		20	six	9		54
five	5		25	six	10		60
five	6		30	six	11		66
five	7		35	six	12		72
five	8		40		7		
five	9		45	Seven	1		7
five	10		50	seven	2		14
five	11		55	seven	3		21
five	12		60	seven	4		28

Multiplication Table.

	7		
seven	5	make	35
seven	6		42
seven	7		49
seven	8		56
seven	9		63
seven	10		70
seven	11		77
seven	12		84
	8		
Eight	1	make	8
eight	2		16
eight	3		24
eight	4		32
eight	5		40
eight	6		48
eight	7		56
eight	8		64
	8		
eight	9		72
eight	10		80
eight	11		88
eight	12		96
	9		
Nine	1	make	9
nine	2		18
nine	3		27
nine	4		36
nine	5		45
nine	6		54
nine	7		63
nine	8		72
nine	9		81
nine	10		90
nine	11		99
nine	12		108

Multiplication Table.

	10		
Ten	1	make	10
ten	2		20
ten	3		30
ten	4		40
ten	5		50
ten	6		60
ten	7		70
ten	8		80
ten	9		90
ten	10		100
ten	11		110
ten	12		120
	11		
Eleven	1	make	11
’leven	2		22
’leven	3		33
’leven	4		44
’leven	5		55
’leven	6		66

	11		
Eleven	7	make	77
’leven	8		88
’leven	9		99
’leven	10		110
’leven	11		121
’leven	12		132
	12		
twelve	1	make	12
twelve	2		24
twelve	3		36
twelve	4		48
twelve	5		60
twelve	6		72
twelve	7		84
twelve	8		96
twelve	9		108
twelve	10		120
twelve	11		132
twelve	12		144

Simple Multiplication.

Lesson 1st.

Page 83.

Multiplicand, 123456 **pair.**
Multiplier, 2

Product, **shoes.**

Divisor and Dividend, } 2)246912

Quotient, **proof.**

Lesson 2nd.

Page 84.

Multiplicand, 654321 **yards.**
Multiplier, 3 **feet in a yd.**

Product, **No. of feet.**

Divisor and Dividend, } 3)1962963

Quotient, **proof.**

Simple Multiplication.

Lesson 3rd.

Page 85.

Multiplicand, 789 bushels.
Multiplier, 4 pecks in a bush.

Product,

Divisor and Dividend, 4)3156

Quotient, 789 proof.

Lesson 4th.

Page 85.

Multiplicand, 987 bills of $5 each.
Multiplier, 5

Product, 4935 dollars in all.

Divisor and Dividend, 5)4935

Quotient, proof.

Simple Multiplication.

Lesson 5th.

Page 86.

Multiplicand, 246 fathom.
Multiplier, 6

Product, feet.

Divisor and Dividend, 6)1476

Quotient, proof.

Lesson 6th.

Page 86.

Multiplicand, 400 weeks.
Multiplier, 7

Product,

Divisor and Dividend, 7)2800

Quotient, proof.

Simple Multiplication.

Lesson 7th.

Page 87.

Multiplicand, 9460 dolls. of 8*s.*
Multiplier, 8

Product, shillings.

Divisor and Dividend, 8(75680

Quotient, proof.

Lesson 8th.

Page 88.

Multiplicand, 20000 kegs.
Multiplier, 9

Product, gallons.

Divisor and Dividend, 9)180000

Quotient, proof.

Money.

£ stands for pounds, *s.* for shillings, *d.* for pence, and *q.* for farthings.

4 Farthings or *q.* make 1 Penny.
12 Pence or *d.* make 1 Shilling.
20 Shillings or *s.* make 1 Pound. £

Write the Pence Table on the Slate in the following manner.

Pence Table.

	Shillings.				*Pence.*		*s.*	*d.*
2	make	24	pence	20	pence	are	1	8
3	make	36	pence	30	pence	are	2	6
4	make	48	pence	40	pence	are	3	4
5	make	60	pence	50	pence	are	4	2
6	make	72	pence	60	pence	are	5	0
7	make	84	pence	70	pence	are	5	10
8	make	96	pence	80	pence	are	6	8
9	make	108	pence	90	pence	are	7	6
10	make	120	pence	100	pence	are	8	4
12	make	144	pence	110	pence	are	9	2

Pence Table.

	s.	d.		s.	d.
13 pence make	1	1	38 pence make	3	2
14 pence make	1	2	39 pence make	3	3
15 pence make	1	3	41 pence make	3	5
16 pence make	1	4	42 pence make	3	6
17 pence make	1	5	43 pence make	3	7
18 pence make	1	6	44 pence make	3	8
19 pence make	1	7	45 pence make	3	9
21 pence make	1	9	46 pence make	3	10
22 pence make	1	10	47 pence make	3	11
23 pence make	1	11	48 pence make	4	0
24 pence make	2	0	49 pence make	4	1
25 pence make	2	1	51 pence make	4	3
26 pence make	2	2	52 pence make	4	4
27 pence make	2	3	53 pence make	4	5
28 pence make	2	4	54 pence make	4	6
29 pence make	2	5	55 pence make	4	7
31 pence make	2	7	56 pence make	4	8
32 pence make	2	8	57 pence make	4	9
33 pence make	2	9	58 pence make	4	10
34 pence make	2	10	59 pence make	4	11
35 pence make	2	11	61 pence make	5	1
36 pence make	3	0	62 pence make	5	2
37 pence make	3	1	63 pence make	5	3

CARD No. 13.

Compound Addition.

Lesson 1st.

Page 91.

£	s.	d.
72	13	4
89	16	3
21	17	4
32	1	8
61	6	3

Lesson 2nd.

Page 92.

£	s.	d.	q.
81	19	4	1
46	7	3	2
31	18	9	3
171	11	5	2
320	10	6	2

Lesson 3rd.

Page 93.

£158	4	3	0
209	6	4	2
48	10	7	1
61	8	9	3
100	9	11	3
100	0	0	0

Lesson 4th.

Page 94.

£21	6	0	0
54	13	0	0
62	15	0	0
35	4	2	0
178	17	3	0
55	19	7	1

Lesson 5th.

Page 95.

A Merchant's Memorandum.

Broadcloth,	£548	14	6
Coating,	361	16	4
Chints,	249	3	7
Calico,	185	14	6
Amount,	£		

Compound Addition.

Lesson 6th.

Page 96.

A Bill of articles bought.

4	Yds. Fustian,	at 4*s*.6*d*.	£0	18	0	0
9	do. Velvet,	9*s*.4*d*.¼	4	4	2	1
16	lbs. Nails,	1*s*.2*d*.	0	18	8	0
5	Gals. Wine,	12*s*.4*d*.	3	1	8	0
4	Bush. Salt,	7*s*.5*d*.	1	9	8	0
6	lbs. Coffee,	2*s*.	0	12	0	0
3	do. Hyson Tea,	9*s*.3*d*.	1	7	9	0
	Amount,		£12	11	11	1

Lesson 7th.

Page 97.

A Farmer's Bill.

Sold 10	fat Oxen	at £18 12	£186	0	0	0
4	Calves,	at 45*s*.	9	0	0	0
15	Sheep,	17*s*.6*d*.	13	2	6	0
12	Store Hogs,	25*s*.3*d*.	15	3	0	0
4	Fat Swine,	135*s*.5*d*.	27	1	8	0
33	Bush. Oats,	2*s*.	3	6	0	0
25	do. Rye,	6*s*.5*d*.	8	0	5	0
	Amount,		£261	13	7	0

Compound Addition.

Lesson 8th.

Page 98.

A Shipper's Memorandum.

	£.	*s.*	*d.*	*q.*
Paid for House Insurance,	784	13	9	0
Ship Washington, do.	867	14	2	0
Duties on the Cargo,	962	13	8	0
Wharfage, . .	42	11	3	0
Repairs, . . .	250	17	11	0
A balance on Goods,	946	10	4	1
Amount,				

Federal Money, or Decimals.

Lesson 9th. Page 99. *Cents.*	*Lesson 10th.* Page 100. *Cents.*
7 8 6 .1	4 8 6 .8
4 6 9 .2	6 4 2 ,9
3 4 1 ,3	3 6 4 .5
7 8 4 .4	4 6 8 .75
8 7 7 .5	6 4 2 .6
4 8 6 .6	5 4 4 .4
6 2 1 ,7	6 8 1 .3
4 3|6 6 .8	3 8|3 1 .2 5

Compound Addition.

Federal Money, or Decimals.

Lesson 11*th.* Page 101. *Cents.*	*Lesson* 12*th.* Page 101. *Cents.*
867·25	1341.2
549·5	2461.2
672·75	1460.1
844·25	0348.5
654·5	0219.0
461·5	0400.0
762.0	4916.0

Lesson 13*th.* Page 102. *Cents.*	*Lesson* 14*th.* Page 103. *Dollars.*
701.	3450.
4809.25	2500.
45.	120.
64.	288.
201.5	192.
8600.	206.25
14420.75	1140.

Compound Subtraction.

Lesson 1st.

Page 104.

£.	s.	d.	q.
782	14	6	1
691	11	3	2

Lesson 2nd.

Page 104.

£.	s.	d.	q.
664	17	3	2
375	18	4	3

Lesson 3rd.

Page 105.

£.	s.	d.	q.
361	16	3	2
48	16	4	1

Lesson 4th.

Page 106.

£.	s.	d.	q.
1000	0	0	0
145	11	0	2

Lesson 5th.

Page 106.

Dollars.	*cents.*
84668	25.5
33768	75.7

Lesson 6th.

Page 107.

Dollars.	*cents.*
87654	37.5
33654	75.

Compound Subtraction.

Lesson 7th.

Page 108.

Memorandum.

Received, 8th May, 1815, the several following sums:

	Dollars.	Cents.
From Government,	221855	25.5
From New-York,	378650	37.5
From Pennsylvania,	183210	50.
From Baltimore,	134765	75.
Amounting to	918481	87.5

Paid out in manner as follows.

	Dollars.	Cents.
To the Surg. Gen.	312750	48.5
To Amer. Invalids,	156375	24.25
To Brit. Invalids,	156375	24.25
Paid out in all,	625500	97.00

What sum remains on hand?

Rec'd in all,	$ 918481	87.5
Paid in all,	$ 625500	97.

After taking the given sums, turn the Card out of view, before adding or subtracting. Let the Key be your guide.

Addition.

Page 111.

5 and 3 are
5 and 6 are
5 and 4 are
5 and 8 are
6 and 7 are
8 and 3 are
7 and 5 are
9 and 4 are
10 and 6 are
11 and 7 are
9 and 6 are
5 and 11 are
12 and 7 are
13 and 5 are
15 and 9 are
13 and 7 are
14 and 6 are
14 and 9 are
17 and 8 are
16 and 5 are
15 and 8 are
19 and 9 are

Subtraction.

Page 111.

remain
3 from 8
6 from 11
4 from 9
8 from 13
7 from 13
3 from 11
5 from 12
4 from 13
6 from 16
7 from 18
6 from 15
11 from 16
7 from 19
5 from 18
9 from 24
7 from 20
6 from 20
9 from 23
8 from 25
5 from 21
8 from 23
9 from 28

Multiplication.

Page 111.

Twice 12 are
3 times 12 are
6 times 7 are
6 times 9 are
7 times 8 are
7 times 9 are
5 times 3 are
5 times 7 are
5 times 9 are
4 times 12 are
4 times 11 are
8 times 9 are
8 times 5 are
8 times 8 are
8 times 12 are
8 times 4 are
10 times 12 are
11 times 7 are
11 times 5 are
10 times 11 are
12 times 11 are
11 times 11 are

Division.

Page 112.

3 in 15
5 in 40
5 in 55
7 in 42
7 in 35
7 in 77
8 in 56
8 in 64
9 in 54
9 in 63
9 in 45
9 in 72
11 in 44
11 in 110
11 in 132
11 in 121
4 in 32
12 in 24
12 in 36
12 in 48
12 in 96
12 in 120

Compound Multiplication.

Lesson 1*st.*

Page 113.

£32 16 8 2
2

Proof of Lesson 1*st.*

Page 114.

2)65 13 5 0

Lesson 2*d.*

Page 114.

£2 5 6 1
3

Proof of Lesson 2.

Page 115.

3)6 16 6 3

Lesson 3*rd.*

Page 115.

£16 16 11 2
4

Proof of Lesson 3*d.*

Page 116.

4)67 7 10 0

Lesson 4*th.*

Page 116.

£24 17 4 3
5

Proof of Lesson 4*th.*

Page 117.

5)124 6 11 3

Compound Multiplication.

Lesson 5th.
Page 118.

£0 7 11 1
6

Proof of Lesson 5th.
Page 118.

6)2 7 7 2

Lesson 6th.
Page 119.

£2 7 8 1
7

Proof of Lesson 6th.
Page 119.

7)16 13 9 3

Lesson 7th.
Page 120.

£80 14 6 2
8

Proof of Lesson 7th.
Page 120.

8)645 16 4 0

Lesson 8th.
Page 121.

£0 10 4 2
9

Proof of Lesson 8th.
Page 121.

9)4 13 4 2

[illegible]

[illegible]

[illegible]

Compound Multiplication.

Lesson 9*th.*

Page 122.

£0 14 4 2
10

Proof of Lesson 9*th.*

Page 122.

10)7 3 9 0

Lesson 10*th.*

Page 123.

£6 17 3 3
11

Proof of Lesson 10*th.*

Page 123.

11)75 10 5 1

Lesson 11*th.*

Page 124.

£1 16 4 2
12

Proof of Lesson 11*th.*

Page 125.

12)21 16 6 0

Lesson 12*th.*

Page 125.

£14 16 8 2
12

Proof of Lesson 12*th.*

Page 126.

£192 17 2 2
—14 16 8 2

Compound Multiplication.

Lesson 13*th.*
Page 126.

£17 6 8
2

Lesson 14*th.*
Page 128.

£461 17 4
5

Lesson 15*th.*
Page 129.

£0 18 9
4

Lesson 16*th.*
Page 130.

£0 19 6
4

Lesson 13*th.* 2*d part.*
Page 127.

£34 13 4
7

Lesson 14*th.* 2*d part.*
Page 128.

£2309 6 8
3

Lesson 15*th.* 2*d part.*
Page 129.

£3 15
4

Lesson 16*th.* 2*d. part.*
Page 130.

£3 18 0
4

pro.
£0 19 6 +

CARD No. 19.

Compound Multiplication.

Lesson 17*th.*

Page 131.

£0 5 9
7

5

£10 1 3

Lesson 18*th.*

Page 131.

£0 0 1 1
10

10

7

£3 12 11

Lesson 19*th.*

Page 132.

£0 3 7
7

8

0 3 7

£10 4 3

Lesson 20*th.*

Page 133.

£0 7 9 1 p.
6

6 p.
11

£25 11 6 66p.
15 6 2p.

68 p.

Compound Multiplication.

Lesson 21st.

Page 135.

A	£0	0	4	2
				10
B		3	9	0
				10
C	1	17	6	0
				11
D	20	12	6	0
Aa			4	2
				11
E		4	1	2
				5
F	1	0	7	2
Dd	20	12	6	0
G	£21	13	1	2

Lesson 22nd.

Page 138.

£0	17	5
		8
6	19	4
		7
48	15	4
		2
£97	10	8

Lesson 23rd.

Page 139.

£0	0	5
		7
	2	11
		8
1	3	4
		2
2	6	8

Multiplication.

Lesson 1st.

Page 141.

Multiplicand,	4 6 4 3 2
Multiplier,	5 2 4
Intermediate products,	1 8 5 7 2 8
	9 2 8 6 4
	2 3 2 1 6 0
Total product,	2 4,3 3 0,3 6 8

Lesson 2nd.

Page 142.

Multiplicand,	6 1 2 4 8
Multiplier,	7 3 2
Intermediate products,	1 2 2 4 9 6
	1 8 3 7 4 4
	4 2 8 7 3 6
Total product,	4 4,8 3 3,5 3 6

Multiplication.

Lesson 3rd.

Page 143.

Multiplicand,	1 6 7 3 9
Multiplier,	2 8 7
	1 1 7 1 7 3
	1 3 3 9 1 2
	3 3 4 7 8
Product,	4, 8 0 4, 0 9 3

Lesson 4th.

Page 144.

Multiplicand,	4 5 6 7
Multiplier,	6 5 2 4
	1 8 2 6 8
	9 1 3 4
	2 2 8 3 5
	2 7 4 0 2
Product,	2 9, 7 9 5, 1 0 8

Compound Multiplication.

Lesson 17*th.*

Page 131.

£0 5 9
7

5

£10 1 3

Lesson 18*th.*

Page 131.

£0 0 1 1
10

10

7

£3 12 11

Lesson 19*th.*

Page 132.

£0 3 7
7

8

0 3 7
£10 4 3

Lesson 20*th.*

Page 133.

£0 7 9 1 p.
6

6 p.
11

£25 11 6 66p.
15 6 2p.

68 p.

Compound Multiplication.

Lesson 21st.

Page 135.

A	£0	0	4	2
				10
B		3	9	0
				10
C	1	17	6	0
				11
D	20	12	6	0
A a			4	2
				11
E		4	1	2
				5
F	1	0	7	2
Dd	20	12	6	0
G	£21	13	1	2

Lesson 22nd.

Page 138.

£0	17	5
		8
6	19	4
		7
48	15	4
		2
£97	10	8

Lesson 23rd.

Page 139.

£0	0	5
		7
	2	11
		8
1	3	4
		2
2	6	8

CARD No. 22.

Division Table.

Page 149.

12,

12 in 24, twice
12 in 36, 3 times
12 in 48, 4 times
12 in 60, 5 times
12 in 72, 6 times
12 in 84, 7 times
12 in 96, 8 times
12 in 108, 9 times

13,

13 in 26, twice
13 in 39, 3 times
13 in 52, 4 times
13 in 65, 5 times
13 in 78, 6 times
13 in 91, 7 times
13 in 104, 8 times
13 in 117, 9 times

14,

14 in 28, twice
14 in 42, 3 times
14 in 56, 4 times
14 in 70, 5 times
14 in 84, 6 times
14 in 98, 7 times
14 in 112, 8 times
14 in 126, 9 times

15,

15 in 30, twice
15 in 45, 3 times
15 in 60, 4 times
15 in 75, 5 times
15 in 90, 6 times
15 in 105, 7 times
15 in 120, 8 times
15 in 135, 9 times

Division Table.

Page 149.

16,

16 in 32, twice
16 in 48, 3 times
16 in 64, 4 times
16 in 80, 5 times
16 in 96, 6 times
16 in 112, 7 times
16 in 128, 8 times
16 in 144, 9 times

17,

17 in 34, twice
17 in 51, 3 times
17 in 68, 4 times
17 in 85, 5 times
17 in 102, 6 times
17 in 119, 7 times
17 in 136, 8 times
17 in 153, 9 times

18,

18 in 36, twice
18 in 54, 3 times
18 in 72, 4 times
18 in 90, 5 times
18 in 108, 6 times
18 in 126, 7 times
18 in 144, 8 times
18 in 162, 9 times

19,

19 in 38, twice
19 in 57, 3 times
19 in 76, 4 times
19 in 95, 5 times
19 in 114, 6 times
19 in 133, 7 times
19 in 152, 8 times
19 in 171, 9 times

CARD No. 23.

Long Division.

Lesson 1st.

Page 149.

Divisor. Dividend. Quotient.

```
16)79392(4962
   64
   ---
   153
   144
   ---
   ..99
     96
     --
     .32
     .32
     ---
     ..
```

Lesson 2nd.

Page 151.

Divisor. Dividend, Quotient.

17)48297(

Lesson 3rd.

Page 152.

Divisor, Dividend. Quotient.

24)98688(

Long Division.

Lesson 4th.

Page 153.

Divisor. Dividend. Quotient.

78)418392(

Lesson 5th.

Page 154.

Divisor. Dividend. Quotient.

96)651744(

Lesson 6th.

Page 155.

Divisor. Dividend. Quotient.

99)977724(

Lesson 7th.

Page 156.

Divisor. Dividend. Quotient.

182)34615(

Lesson 8th.

Page 157.

Divisor. Dividend. Quotient.

194)64329(

Lesson 9th.

Page 158.

Divisor. Dividend. Quotient.

43|00)6849|27(159$\frac{1227}{4300}$

Long Division.

Lesson 10.

Page 159.

Divisor. Dividend. Quotient.
56|00)12882|41(

Lesson 11.

Page 160.

Divisor. Dividend. Quotient.
346)8123187(

Lesson 12.

Page 161.

Divisor. Dividend. Quotient.
123)123456789(

Lesson 13.

Page 162.

Divisor. Dividend.
2|0)78433

Lesson 14.

Page 163.

Divisor. Dividend.
4|0)98643

Lesson 15.

Page 163.

Divisor. Dividend.
6|0)39645

Proof of Long Division.

Lesson 4.

Page 164.

The Quotient is 5364
The Divisor, 78

Lesson 5.

Page 164.

The Quotient, is 6789
The Divisor, 96

Lesson 6.

Page 164.

The Quotient, is 9876
The Divisor, 99

Lesson 7.

Page 164.

Divisor, 182
Quotient, 190 Rem. 35.

Lesson 8.

Page 164.

The Divisor is 194
The Quotient, 331 Rem. 115

Lesson 9.

Page 164.

The Quotient, 159
The Divisor, 4300 Rem. 1227

Compound Division.

Lesson 1st.

Page 165.

4)784*l.* 16*s.* 4*d.*

Lesson 2nd.

Page 165.

8)1454*l.* 19*s.* 0*d.* 0*q.*

Lesson 3rd.

Page 166.

12)1173*l.* 12*s.* 9*d.* 0*q.*

Lesson 4th.

Page 166.

```
19)35l. 12s. 6d.(1l.
   19
   ——
   16
   20
   ——
19)332(17s.
   19
   ——
   142
   133
   ———
   ..9
    12
   ———
19)114(6d.
   114
   ———
   ...
```

A NOTE OMITTED.

Cards of Tables of Weights and Measures ought to be suspended in the room for continual inspection.

When a class has done reading, question them: How many pence in a shilling? How many pounds in a quarter of a cwt.? How many feet in a rod? How many ounces in a pound Troy? How many in a pound Avoirdupois? How many are 3 times 6? 4 times 6? 5 times 6? 6 times 6? 7 times 6?

Go through with the Multiplication and other Tables in this manner by piecemeal from day to day, seasonably, that the pupils may be able to work in any rule without looking at the Table.

Let all pupils omit Weights and Measures, till coming to Reduction. See REMARKS, page 197.

Again: Form the Roman text alphabet with capital and small letters on a board, and place it in view of all the learners. Make the body of the small letters of about three inches in length, and the other marks in proportion; and, place a number in figures over each letter. In preparing for spelling a lesson, let a monitor pronounce a word, and point to the number of each letter, when the pupils will write on their slates accordingly.

Compound Division.

Lesson 5th.
Page 168.

£. s. d.
23)179 17 7(

Lesson 7th.
Page 170.

£. s.
33)486 15(

Lesson 9th.
Page 171.

£. s. d.
89)28 3 8(

Lesson 11th.
Page 173.

£9 8 4
4

Lesson 13th.
Page 175.

s. d. q.
7)79 4
8)
2)

Lesson 6th.
Page 169.

£. s. d.
26)239 4 0(

Lesson 8th.
Page 170.

£. s. d.
47)566 7 0(

Lesson 10th.
Page 172.

£ s. d. q.
2 19 11 1
4

Lesson 12th.
Page 173.

£34 0 3 3
4

Lesson 14th.
Page 176.

£ s. d. q.
5)14 14 8
8)
7)
2)

Decimals.

Arithmetical Characters.

Page 177.

= Equal to. + More or Addition. — Less, or Subtraction. × Multiplication.) (÷ Division. : : Proportion.

See Explanation, pages 177, 178.

⌉ Square. √ Square Root.

Lesson 1st.

Page 179.

4)1.00(.25
8
—
20
20

Lesson 2nd.

Page 180.

2)1.0(.5
10
—

Lesson 3rd.

Page 181.

4)3.00(

Lesson 4th.

Page 181.

8)7.000(

Lesson 5th.

Page 181.

20)19.00(

Lesson 6th.

Page 181.

.25	hundredths
.5	tenths
.75	hundredths
.875	thousandths
.95	hundredths

Decimals.

Lesson 7th.

Page 182.

	£3.325
	20
Shillings,	6.500
	12
Pence,	6.000

Proof of Lesson 6th and 7th, Page 182, by mental and practical calculation.

			£	s	d
$\frac{1}{4}$ or .25	of a pound=	£	0	5	0
$\frac{1}{2}$ or .5	of a pound=		0	10	0
$\frac{3}{4}$ or .75	of a pound=		0	15	0
$\frac{7}{8}$ or .875	of a pound=		0	17	6
$\frac{19}{20}$ or .95	of a pound=		0	19	0
		£	3	6	6

CARD No. 27.

Decimals.

Lesson 8*th.*

Page 182.

12)1.000(

Lesson 9*th.*

Page 184.

15)8.00000(

TABLE.

Page 185.

Units,	Tenths,	Hundredths,	Thousandths,	Tens of thousandths,	100 of thousandths,	Millionths,
·	1	2	3	4	5	6

Lesson 10*th.*

Page 186.

.25
100

Lesson 11*th.*

Page 187.

.5
100

Lesson 12*th.*

Page 187.

.75
20

Lesson 13*th.*

Page 187.

.875
100

Lesson 14*th.*

Page 187.

.8
100

Lesson 15*th.*

Page 187.

.75
12

Decimals.

Lesson 16*th.*

Page 187.

.95

20

Lesson 17*th.*

Page 187.

.8125

12

Lesson 18*th.*

Page 187.

.0625

112

Lesson 19*th.*

Page 188.

.1875

112

Lesson 20*th.*

Page 188.

.75

60

Lesson 21*st.*

Page 188.

.790625

20

Lesson 22*nd.*

Page 188.

.1875

20

Lesson 23*rd.*

Page 189.

```
  4.|3.
 12.|9.75
 20.|15.8125(.790625
     140
    -----
     .181
      180
     ------
      ..125
        120
       ------
        ..50*
          40
         -----
          100*
          100
         -----
          000
```

Decimals.

Lesson 24th.

Page 189.

4.	3.
12.	6.
20.	12.

Lesson 25th.

Page 189.

4.	3.
12.	9.

Lesson 26th.

Page 189.

4.	3.
12.	0.

Lesson 27th.

Page 189.

12.	6.
8.	3.

Lesson 28th.

Page 189.

12.	3.
8.	7.

Lesson 29th,

Page 190.

12.	6.
6.	2.

Lesson 30th,

Page 190.

12.	9.
7.5	3.

Lesson 31st,

Page 190.

4.	2.
12.	10.
7.5	1.

Lesson 32nd.

Page 190.

£25 17 6

Reduction.

Avoirdupois Weight.

Lesson 1st.

Page 194.

lb.

6|0)144|0

24. Bush.

Lesson 2nd.

Page 194.

lb.

6|0)18000

2|0)

loads

Lesson 3rd.

Page 194.

	lb.
1 Load,	1235
2	1245
3	1231
4	1242

6|0)495|3 [lb

82B. 33

Lesson 4th.

Page 194.

cwt.	*qr.*	*lb.*
14	2	25

Directions.

14 × 4 + 2 = 58.

58 × 28 + 25 = 1649

Lesson 5th.

Page 194.

lb.

1649.

Directions.

1649 ÷ 28 = 58 and 25 over.

58 ÷ 4 = 14 and 2 over.

Lesson 6th.

Page 195.

oz.

33152.

Lesson 7th.

Page 195.

cwt.	*qrs.*
18	2.

Reduction.

Avoirdupois Weight.

Lesson 8th.

Page 195.

	cwt.	qrs.	lb.
1 hhd.	12	1	14
2	11	2	21
3	12	3	15
4	12	0	25
	49	0	19

Lesson 9th.

Page 196.

cwt.	qrs.	lb.
49	0	19
12	0	25

Lesson 10th.

Page 196.

	cwt.	qrs.	lb.	oz.
4)	49	0	19	

Lesson 11th.

Page 196.

cwt.	qrs.	lb.
82	2	22
41	1	11

Lesson 12th.

Page 198.

157 barrels.
27 lb. tare
[on each.

363 lb. gross ×
157 barrels.

Reduction.

Troy Weight.

Lesson 1st.

Page 199.

lb. oz.
30 11
12

20

Lesson 2nd.

Page 199.

lb. oz. pwt.
8 3 15
12

Lesson 3rd.

Page 200.

pwts.
1 lb. × 12 × 20 = 240
6 oz. × 20 = 120
2 oz. × 20 = 40
½ oz. = 10

Apothecaries' Weight.

Lesson 1st.

Page 201

℔	℥	ʒ	℈	gr.
5	8	4	2	17

Lesson 2nd.

Page 201.

grains.
2|0)329|7
3)1646 17 gr.
8) 548 2 ℈
12) 68 4 ʒ
℔ 5 8 ℥

Lesson 3rd.

Page 201.

	℥	ʒ	℈	
Mix	3	5	1	aloes
	4	7	2	rhu.
	2	6	1	soap
	2	1	2	cal.

Reduction of

Lesson 8th.

Page 211.

25×40=1000 links. 25×18=450 L.

450 links the breadth } multiplied=
1000 the length }

450000 links the area required.

EXAMPLE A.

Page 212.

100000)450000(4 acres.
400000

.50000
× by 4 roods in an acre.

100000)200000(2 roods.
200000

EXAMPLE 1, B,

Page 212.

450000 links.
Acres, 4.50000
4 roods in an acre.

Roods, 2.00000

Land and Square Measure.

2, C.

Page 212.

In 4816235 links how many acres?

Acres, 48·16235 links.

4

Parts of a rood, ·64940

40

Perches, 25·97600

3, D.

Page 213.

In 7583100 links, how many acres?

Acres, 75·83100 Multiply as above.

E.

Page 213.

75·831 acres.

F.

Page 213.

Sums in Links.	*Answers in Ch. and Links.*
750	7.50
465	4.65
4475	44·75
4052	40·52
1114	11·14
110121	1101·21

Proportion.

Lesson A.

Page 246.

B. s. B.
2 : 6 : : 4

Lesson B.

Page 246.

B. s. B.
2 : 4 : : 7

Lesson 1st.

Page 247.

lb. d. lb.
5 : 80 : : 9

Lesson 2nd.

Page 247.

lb. d. lb.
5 : 80 : : 1

Lesson 3rd.

Page 248.

lb. d. lb.
1 : 16 : : 5

Lesson 4th.

Page 248.

P. s. P.
8 : 1152 : : 12

Lesson 5th.

Page 249.

yds. s. yd.
432 : 1728 : : 1

Lesson 6th.

Page 249.

H. B. H.
6 : 9 : : 24

Lesson 7th.

Page 250.

B. s. B.
144 : 50 : : 12

Lesson 8th.

Page 251.

G. d. G.
32 : 3080 : : 120

Compound Proportion.

Lesson C.

Page 264.

men. d. acres.
4 : 8 : : 16

Lesson D.

Page 264.

men. d. acres.
4 : 8 : : 16
4 : : 48

Operation.

Page 265.

48 fifth term,
8 2nd. term,
384
4 first term.
1536 a dividend.

16 third term.
4 fourth term.
64 a divisor.
64)1536(24 Ans.
128
256
256

Lesson 1*st.*

Page 265.

P. mo. bush.
7 : 4 : : 56
46 : 10

Lesson 2*nd.*

Page 266.

men. d. dol.
8 : 4 : : 8
48 : 16

Lesson 3*rd.*

Page 267.

h. d. bush.
18 : 20 : : 10
60 : 36

Lesson 4*th.*

Page 267.

hd. d. miles.
12 : 12 : : 240
16 : : : 720

Interest.

Lesson 3rd. Page 275.

£. 13 17*s*. 6*d*. principal.
6 rate per cent.

83 5 0
20 Cutting off two ciphers divides by 100.
s.16|65
12
d.7|80
4
q.3|20 Interest £0 16*s*. 7*d*. 3*q*. $\frac{20}{100}$

Lesson 4th. Page 276.

155 dol. = 15500 cents principal.
2

31000 product by 2
7750 half the principal.
387|50

Ans. $3 87.5 cents, interest 1 year.

Lesson 5th. Page 276.

Principal, 23100
Rate per cent, 3.25

1155
462
693

Int. 1 yr. at $3\frac{1}{4}$ per cent. 750|75.00

Practice.

Page 301.

20 quills at 3 farthings each.

2 farthings, are half a penny,	2	$\frac{1}{2}$	20
1 farthing is half a halfpenny,	1	$\frac{1}{2}$	10
			5
			15*d*.

Lesson 3rd.

Page 303.

1*d*.	$\frac{1}{12}$*s*.	8612 at 1*d*. 1*q*.
1*q*.	$\frac{1}{4}$*d*.	717 8*d*.
		179 5
2|0		89|7 1

Ans. £.44 17*s*. 1*d*.

Lesson 4th.

Page 303.

1*d*.	$\frac{1}{12}$*s*.	4121 at 1*d*. 2*q*.
2*q*.	$\frac{1}{2}$*d*.	343 5
		171 8 2
2|0		51|5 1 2

Ans. £25 15 1 2

Lesson 7th.

Page 304.

2*d*.	$\frac{1}{6}$*s*.	6181 at 2*d*. 1*q*.
		1030 2
		128 9 1
2|0		115|8 11 1

Ans. £. 57 18 11 1

Lesson 8th.

Page 304.

2*d*.	$\frac{1}{6}$*s*.	1218 at 2*d*. 2*q*.
2*q*.	$\frac{1}{4}$	203
		50 9
2|0		25|3 9

Ans. £. 12 13 9

SUPPLEMENT

TO

"EVERY MAN HIS OWN TEACHER."

DECIMALS.

RULE IN MULTIPLICATION.

Point off so many decimals in the product, as there are in the two factors counted together.

RULE IN DIVISION.

The decimals in the divisor and quotient, counted together, must be equal in number to the decimals in the dividend.

EXAMPLES.

1. Multiply 486.5	Proof by division.
by 3.25	3.25)1581.125(486.5
	1300
24325	
9730	.2811
14595	2600
1581.125	.2112
	1950
	.1625
	1625

2. Multiply 34.21	
by 64.8	64.8)2216.808(34.21
	1944
27368	
13684	.2728
20526	2592
2216.808	.1360
	1296
	..648
	648

REMARKS.

1st. In Division, begin by counting the Decimals in the dividend; then begin again and count the Decimals in the divisor, turn from that to the right of the quotient and continue counting towards the left, till you have a number equal to the Decimals in the dividend; there place the point.

2d. If, after Division is performed, there is not a sufficient number of Decimals in the divisor and quotient, counted together, then prefix cyphers to the quotient, till the deficiency in number is made good.

3d. When the dividend is too small to admit the divisor, annex cyphers to the dividend; five in number for a general rule, but sometimes less, and sometimes more, according to the nature of the case under consideration.

EXAMPLES.

1. Divide 2.08080 by 4624. Make it .00045

4624.)2.08080(.00045
18496

.23120
23120

2. Divide 165. by 220. Make it .75

220)165.00(.75
1540

.1100
1100

3. Divide 8.5800 by 3432. Make it .0025

3432.(8.5800(.0025
6864

17160
17160

DIRECT PROPORTION; OR, THE SINGLE RULE OF THREE MADE DIRECT IN ALL CASES.

RULE.

Compare objects with objects of the same name and kind; as, prices with prices, or dollars with dollars, shillings with shillings, bushels with bushels, gallons with gallons, ounces with ounces, &c. for the two first terms; then place that which is of the same name of the answer, in the third term.

EXAMPLE 1.

If 2 gallons cost 8s. what will 4 gallons cost?

g. g. s.
2 : 4 :: 8 to a fourth number.
4

2)32(16s. answer.

Proportional Statement.

When the nature of the question shows that the answer must be *greater* than the sum in the *demand*, then take the *lesser* term in the *supposition* for the first; but if it appear that the answer must be *less* than the *demand*, then take the *greater* term in the *supposition* for the first.

EXAMPLE 2.

If 4 men can do a piece of work in 10 days, how many men will be sufficient to do the same in 20 days?

D. D. M.
20 : 10 : : 4
    4
  —
20)40(2 men, for answer.

Although this question is of the inverse kind, yet the method of stating affords a direct operation, and will hold good in all cases.

EXAMPLE 3.

If 6 men can do a piece of work in 5 days, how many men can do the same in 15 days? Answer, 2 men.

In this example we perceive, that the answer in men will require a less number than 6 mentioned in the supposition; therefore take the greatest number of days, in the supposition and demand, for the first term, and the other for the second.

OPERATION.

D. D. M.
15 : 5 :: 6 to a fourth number.
    6
  —
15)30(2 answer.

Say, as 15 days are to 5 days, so are 6 men to a fourth number, or the number of men required.

PROOF OF EXAMPLE 3.

If 2 men can do a piece of work in 15 days, how many men can do the same in 5 days? Answer, 6 men.

Here the nature of the question shows, that the answer must be greater than the number of men in the supposition; thus,

D. D. M.
5 : 15 : : 2 to a fourth number,
    2
  —
5)30(6 answer.

N. B. In Compound Proportion, or Double Rule of Three, make two statements.

PRACTICE GENERALIZED;

OR,

THE DIFFERENT CASES IN PRACTICE WROUGHT UNDER ONE CASE.

RULE.

Find the price of unity, or one, in the denomination next above the highest denomination in the given price; this will immediately give the price of the given number of intigers; then take parts in the usual manner.

EXAMPLES.

LESSON 1.

1817 at 1*q*. Say, 1817 at 1*d*. the next higher denomination; then divide by 12 and by 20, which operation will make £7 11*s*. 5*d*.; then divide that sum by 4, and the quotient will be the answer; because 1*q*. is the fourth of a penny.

For example, if 1817 apples, at 1*d*., will amount to £7 11*s*. 5*d*., they will amount to one fourth of this sum at a farthing, viz. £1 17*s*. 10*d*. 1*q*.

OPERATION.

12|1817*d*.
20| 151*s*. 5*d*.
4| 7 11*s*. 5*d*.
Ans. £1 17*s*. 10*d*. 1*q*.

PROOF.

1*q*. ¼ 1*d*.|1817 at 1*q*.
12| 454 1*q*.
÷ 20| 37 10*d*.
Ans. £1 17*s*. 10*d*. 1*q*.

LESSON 2.

1817 at 3 qrs.

Here as in lesson first we say 1817*d.* which sum, divided by 12 and by 20, will make £7 11*s.* 5*d.* as before; then the half of this sum, and the half of that half, will be equal to the amount at 3*q.*: because 2 *q.* are equal to half a penny, and 1*q.* is equal to half of 2*q.*

Operation.

12	1817*d.*
20	151*s.* 5*d.*
2*q.* ½ of 1*d.*	£7 11 5*d.*
1*q.* ½ of 2*q.*	3 15*s.* 8*d.* 2*q.*
	1 17 10 1
Answer,	£5 13 6 3

Proof.

2*q.* ½ of 1*d.*	1817 at 3*q.*
1*q.* ½ of 2*q.*	908*d.* 2*q.*
	454 1
12	1362*d.* 3*q.*
÷ 20	113*s.* 6*d.* 3*q.*
Answer	£5 13*s.* 6*d.* 3*q.*

LESSON 3.

1691 at 1*d.* 2*q.* In this lesson we say 1691 at 1*s.* makes £84 11*s.* Then 1*d.* is $\frac{1}{12}$ of a shilling and 2*q.* ½ of a penny; that is, the $\frac{1}{12}$ of £84 11 and the half of that $\frac{1}{12}$ will give the answer, viz. £10 11 4 2

Operation.

÷ 20	1691 at 1*s.*
1*d.* $\frac{1}{12}$ of 1*s.*	£84 11*s.*
2*q.* ½ of 1*d.*	7 0*s.* 11*d.*
	3 10*s.* 5*d.* 2*q.*
Answer,	£10 11*s.* 4*d.* 2*q.*

Proof.

1*d.* $\frac{1}{12}$ of 1*s.*	1691 at 1*d.* 2*q.*
2*q.* ½ of 1*d.*	140*s.* 11*d.*
	70*s.* 5*d.* 2*q.*
÷ 20	211*s.* 4*d.* 2*q.*
Answer,	£10 11*s.* 4*d.* 2*q.*

LESSON 4.

1881 at 2*s.* 3*d.* 2*q.* Say 1881 at 20*s.* = £1881. Then 2*s.* is $\frac{1}{10}$ of a pound, 3*d.* ⅛ of 2*s.* and 2*q.* ⅙ of 3*d.*

Operation.

2*s.* $\frac{1}{10}$ of £1	£1881
3*d.* ⅛ of 2*s.*	188 2*s.*
2*q.* ⅙ of 3*d.*	23 10*s.* 3*d.*
	3 18*s.* 4*d.* 2*q.*
Answer,	£215 10*s.* 7*d.* 2*q.*

Proof.

3*d.* ¼ of 1*s.*	1881 at 2*s.* 3*d.* 2*q.*
	2*s.*
	3762*s.*
2*q.* ⅙ of 3*d.*	470*s.* 3*d.*
	78*s.* 4*d.* 2*q.*
÷ 20	4310*s.* 7*d.* 2*q.*
Answer,	£215 10*s.* 7*d.* 2*q.*

LESSON 5.

478 at 3*s.* 2*d.* 1*q.*

Operation.

2*s.* $\frac{1}{10}$ of £1	£478
1*s.* ½ of 2*s.*	47 16*s.*
2*d.* ⅙ of 1*s.*	23 18*s.*
1*q.* ⅛ of 2*d.*	3 19*s.* 8*d.*
	9*s.* 11*d.* 2*q.*
Answer,	£76 3*s.* 7*d.* 2*q.*

Proof.

2*d.* ⅙ of 1*s.*	478 at 3*s.* 2*d.* 1*q.*
	3*s.*
	1434*s.*
1*q.* ⅛ of 2*d.*	79*s.* 8*d.*
	9*s.* 11*d.* 2*q.*
÷ 20	1523*s.* 7*d.* 2*q.*
Answer,	£ 76 3*s.* 7*d.* 2*q.*

LESSON 6 *and* 7.

What will 568 pairs of mittens come to at 2s. 6d. a pair, and at 3s. 4d. a pair? Ans. £71 at 2s. 6d. and £94 13s. 4d. at 3s. 4d.

EXPLANATION.

In the first place we consider 568 pairs at 20s. equal to £568. Then as 2s. 6d. is $\frac{1}{8}$ of a pound, we divide by 8, the quotient is the answer at 2s. 6d.

Secondly, we say 3s. 4d. is $\frac{1}{6}$ of a pound, and divide by 6, the quotient will be the answer at 3s. 4d.

Operations.

2s 6d. $\frac{1}{8}$ of £1	568 at 2s. 6d.
	Answer, £71

3s. 4d. $\frac{1}{6}$ of £1	568 at 3s. 4d.
	Answer, £94 13s 4d.

LESSON 8 *and* 9.

678 at 5s. and at 6s. 8d.

Operations.

5s. $\frac{1}{4}$ of £1)	678 at 5s.
	Answer, £169 10s.

6s. 8d. $\frac{1}{3}$ of £1)	678 at 6s. 8d.
	Answer, £226

LESSON 10.

678 at 7s. 6d. 2q.

Directions.

Say 678 at 20s.=£678. Then take parts of that sum thus: 4s.=$\frac{1}{5}$ of a pound; 2s.=$\frac{1}{2}$ of 4s.; 1s.=$\frac{1}{2}$ of 2s.; 6d.=$\frac{1}{2}$ of 1s. and 2q.=$\frac{1}{12}$ of 6d.

Operation.

4s. $\frac{1}{5}$ of 1£.	£678 at 7s. 6d. 2q.
2s. $\frac{1}{2}$ of 4s.	135 12s.
1s. $\frac{1}{2}$ of 2s.	67 16s.
6d. $\frac{1}{2}$ of 1s.	33 18s.
2q. $\frac{1}{12}$ of 6d.	16 19s.
	1 8s. 3d.
	Answer, £255 13s. 3d.

Proof.

6d. $\frac{1}{2}$ of 1s.	678
	7
	4746s.
2q. $\frac{1}{12}$ of 6d.	339s.
	28s. 3d.
÷ 20	5113s. 3d.
	Answer, £255 13s. 3d.

LESSON 11.

459 at 15s. 8d. 3q.

Here we will suppose that 459 cost £459. Then say, 10s.=$\frac{1}{2}$ of a pound; 5s.=$\frac{1}{2}$ of 10s.; 6d.=$\frac{1}{10}$ of 5s.; 2d.=$\frac{1}{3}$ of 6d.; 2q.=$\frac{1}{4}$ of 2d. and 1q.=$\frac{1}{2}$ of 2q.

Operation.

10s. $\frac{1}{2}$ of 1£.	459 at 15s. 8d. 3q.
5s. $\frac{1}{2}$ of 10s.	229 10s.
6d. $\frac{1}{10}$ of 5s.	114 15s.
2d. $\frac{1}{3}$ of 6d.	11 9s. 6d.
2q. $\frac{1}{4}$ of 2d.	3 16s. 6d.
1q. $\frac{1}{2}$ of 2q.	0 19s. 1d. 2q.
	9s. 6d. 3q.
	Answer, £360 19s. 8d. 1q.

Proof.

6d. $\frac{1}{2}$ of 1s.	459
	× 3
	1377
	× 5
	6885s.
2d. $\frac{1}{3}$ of 6d.	229s. 6d.
2q. $\frac{1}{4}$ of 2d.	76s. 6d.
1q. $\frac{1}{2}$ of 2q.	19s. 1d. 2q.
	9s. 6d. 3q.
÷ 20	7219s. 8d. 1q.
	Answer, £360 19s. 8d. 1q.

LESSON 12.

642 at 37*s.* 6*d.* 2*q.*

STATEMENT.

Say 642 pounds; this will include the amount of the integers at 20*s.* each: then for 17*s.* 6*d.* 2*q.* say 10*s.* = $\frac{1}{2}$ of a pound; 5*s.* = the half of 10*s.*; 2*s.* 6*d.* = the half of 5*s.* and 2*q.* = $\frac{1}{60}$ of 2*s.* 6*d.*

OPERATION.

10*s.* $\frac{1}{2}$ of 1£. | £642
5*s.* $\frac{1}{2}$ of 10*s.* | 321
2*s.* 6*d.* $\frac{1}{2}$ of 5*s.* | 160 10*s.*
2*q.* $\frac{1}{60}$ of 2*s.* 6*d.* | 80 5*s.*
1 6*s.* 9*d.*

Answer, £1205 1*s.* 9*d.*

PROOF.

6*d.* $\frac{1}{2}$ of 1*s.* | 642
× 37*s.*

4494
1926

23754*s.*
2*q.* $\frac{1}{12}$ of 6*d.* | 321*s.*
26*s.* 9*d.*

÷ 20 | 24101*s.* 9*d.*
Answer, £1205 1*s.* 9*d.*

LESSON 13.

What cost 15 tons 9 cwt. 3 qrs. 25 lb. of iron, at £2 16*s.* a hundred?
Answer, £867 18*s.* 6*d.*

DIRECTIONS.

1. Multiply the price of 1 cwt. by 20, the product will be the price of 1 ton.
2. Multiply the price of 1 ton by 15, the product will be the price of 15 tons.
3. Multiply the price of 1 cwt. by 9, the product will be the price of 9 cwt.
4. For the 3 qrs. 25 lb. say, 2 qrs. = $\frac{1}{2}$ of 1 cwt.; 1 qr. = $\frac{1}{2}$ of 2 qrs.; 14 lb. = $\frac{1}{2}$ of 1 qr.; 7 lb. = $\frac{1}{2}$ of 14 lb.; and 4 lb. = $\frac{1}{28}$ part of 1 cwt.

OPERATION.

2 qrs. $\frac{1}{2}$ of 1 cwt. | £2 16*s.* price of 1 cwt.
4

11 4
5

Price of 1 ton, 56 0
3

168 0
5

$ 840 0

£840 0*s.* price of 15 ton.
£2 16*s.* × 9 = 25 4 price of 9 cwt.
1 qr. $\frac{1}{2}$ of 2 qrs. | 1 8 price of 2 qrs.
14lb. $\frac{1}{2}$ of 1 qr. | 14 price of 1 qr.
7lb. $\frac{1}{2}$ of 14lb. | 7 price of 14lb.
3 6*d.* price of 7lb.
4lb. = $\frac{1}{28}$ of 1 cwt. | 2 0*d.* price of 4lb.

Answer, £867 18 6

Proof in dollars and cents, at the rate of 8*s.* to the dollar.

2 qrs. $\frac{1}{2}$ of 1 cwt. | $7. price of 1 cwt.
20 cwt. 1 ton.

140 price of 1 ton.
5

700

	$ 700	
	3	
	2100.	price of 15 tons,
$7 × 9 =	63.	price of 9 cwt.
1 qr. ½ of 2 qrs.	3.50	price of 2 qrs.
14lb. ½ of 1 qr.	1.75	
7lb. ½ of 14lb.	.875	
	.4375	
4lb. = $\frac{1}{28}$ of 1 cwt.	.2500	

$ 2169.8125 Answer, $ 2169.81¼ cents.

INTEREST.

How to find the time a Note or Bond has been on Interest.

LESSON 1.

Suppose a note was given on interest April 2, 1813, and paid March 4, 1816; how many years, months, and days does it draw interest?
Answer, 2 years 11 mo. and 2 days.

Operation.

March 4, 1816,	1816 years	2 mo.	4 days.
April 2, 1813,	1813	3	2
Answer,	2	11	2

Allow 30 days to be 1 month and 12 months 1 year.

Observations.

1. The Note was paid on the 4th of March 1816, which time we call 1816, years on New-year's day last before the payment, and the 4th of March we say is 2 months and 4 days after New-year's day.

2. So again for the time of signing the note, we say that the 2nd of April was 3 months and 2 days after New-year's day 1813. Subtract and carry at 30 and at 12.

Application.

What is the interest of a Note of $ 450.75 for 2 years 11 mo. and 2 days at 7 per cent. per annum? Answer, $ 92.20+

Directions.

First, find the interest for three years; then take one twelfth of one year's interest from that sum, the difference will be 2 years 11 mo. interest. Secondly, take the 15th part of one month's interest for 2 days.

Operation.

45075 cents.
7 per cent.

3155.25 one year's interest.
3 years the time.

9465.75 three years' interest.
262.93 one month's interest subtracted.

9202.82 two years' and 11 months' interest.
17.528 two days' interest or 15th of 1 mo.

9220.348 Answer, $ 92.20 cents, and .348+ thousandths of a cent.

LESSON 2.

If a note were given on interest, 5th May, 1812, and paid March 2, 1817, what time should be allowed for interest?

Ans. 4 years, 9 mo. 27 days.

OPERATION.

March 2, 1817,	1817 years,	2 mo.	2 days.
May 5, 1812,	1812	4	5
	. . . 4	9	27

APPLICATION.

What is the amount of $16.50, for 4 years, 9 months and 27 days, at 7 per cent. per annum? Ans. $22.07+

OBSERVATIONS.

1. In this case obtain the interest for 4 years; then take half the interest for 1 year, and the half of that half for 9 months.

2. For 27 days, divide the interest of 1 year by 12, the quotient will be the interest of 1 month, viz. 9.6250 cents; subtract $\frac{1}{10}$ of a month's interest, that is 3 days, from that sum, the remainder will be 27 days' interest, viz. 8.6625 cents.

OPERATION.

	1650		cents, principal.
	7		rate per cent.
6 mo. ½ a yr.)	115	50	interest for 1 year.
		4	
	462	00	interest for 4 years.
3 mo. ½ of 6)	57	75	interest for ½ a year.
	28	875	interest for ¼ of a year.
	8	6625	interest for 27 days.
	557	2875	interest for 4 years, 9 mo. 27 days.
	1650		principal.
	2207	2875	amount, or answer.

12)115.50 cts.	1 year.
10)9.6250	1 month.
.9625	3 days.
8.6625	27 days.

COMPOUND INTEREST, CALCULATED BY LOGARITHMS.

RULE.

Add the rate per cent. to 100; find the Logarithm of that sum, and subtract from it the Logarithm of 100; call the difference, *Logratio;* multiply the Logratio by the number of years, and to that product add the Logarithm of the principal; the natural number of the last Logarithm will be the *amount* in Compound Interest.

EXAMPLE 1.

What is the amount of $500 for three years, at 7 per cent. per annum, compound interest? Ans. $612.50

OPERATION.

Rate per cent. 7 + 100 = 107. Logarithm of 107 is	2.02938
Logarithm of 100 is	2.00000
Logratio or difference,	0.02938
Number of years, ×	3
Product,	0.08814

[Continued.

Product, 0.08814
Principal 500. The Logarithm of which is 2.69897

Logarithm of the amount 2.78711

The natural number to 2.78711 is 612.5, the amount required.

PROOF TO EXAMPLE 1.

\$500 principal.
7 rate per cent.

35|00 interest for 1st year.
500| principal.

535| amount of 1st year.

\$535 principal 2d year.
7 rate per cent.

37|45 interest 2d year.
535| principal.

572|45 amount 2d year.

\$572.45 principal 3d year.
7 rate per cent.

40|07.15 interest 3d year.
572|45 principal.

\$612|5215 amount.

EXAMPLE 2.

What is the compound interest of 6000 cents, for 4 years, at 5 per cent per annum? Ans. \$12.93

OPERATION.

Rate per cent. 5 + 100 = 105. Logarithm of 105 is 2.02119
Logarithm of 100 is 2.00000

Difference or Logratio, 0.02119
Number of years, × 4

Product, 0.08476
Principal 6000; Logarithm of which is 3.77815

Natural number 7293 of the last Logarithm, 3.86291
This number 7293 cents, is the amount.
Subtract 6000 the principal.

Leaves 1293 cents for interest, or answer.

PROOF OF EXAMPLE 2.

6000 cents, principal.
5 rate per cent.

300|00 interest for 1st year.
6000| principal.

6300|00 amount for the first year.

6300 principal for 2d year.
5 rate per cent.

315|00 interest for 2d year.
6300| principal.

6615| amount for 2d year.

6615 cts. principal for 3d year.
5 rate per cent.

330|75 interest for 3d year.
6615| principal.

6945|75 amount for 3d year.

6945.75 cts. principal for 4th yr.
5 rate per cent.

347|28.75 interest for 4th year.
6945|75 principal.

7293|0375 amount for 4th year.
6000| 1st prin. to be subtracted.

1293.0375 interest for 4 years.

Logarithm Tables may be had at book-stores; they are printed and bound like a pamphlet. They are also inserted in books on Surveying, Navigation, &c.

Mr. Chapman's patent sliding Interest Table, is an ingenious piece of of work, and very convenient in computing simple interest.

RATE-BILL.

If the value of the real and personal estates, in any city or town, be rated at 34562 dollars, and a tax of 565 dollars be imposed thereon, it is required to ascertain how much that will be on a dollar?

Answer, .01634743+

PROPORTIONAL STATEMENT AND OPERATION.

```
34562 : 565.00000000 : : 1

34562)565.00000000(.01634743+ quotient.
      34562
      ------
     .219380
      207372
      ------
     .120080
      103686
      ------
      .163940
       138248
      ------
      .256920
       241934
      ------
       .149860
        138248
       ------
        .116120
         103686
        ------
        .12434
```

DIRECTIONS.

1. Find how much this tax will be on a dollar, by making a statement in Proportion as above; by that we find it will be .01634743 of a dollar; but in order to make the result great enough to prove the work after calculating several different shares, we will alter the last figure 3 in the decimal number .01634743 and make it a 4. This method will cause us to gain a small fraction rather than to lose.

2. Multiply this *decimal number*, or *common multiplier*, or *ratio* if you please, by 2, by 3, by 4, by 5, by 6, by 7, by 8, by 9, and by 10. Place these products under each other for a scale, which will enable us to calculate any number or share by inspection.

OPERATION AND EXAMPLE.

No.	1	.0	1	6	3	4	7	4	4
×	2	.0	3	2	6	9	4	8	8
×	3	.0	4	9	0	4	2	3	2
×	4	.0	6	5	3	8	9	7	6
×	5	.0	8	1	7	3	7	2	0
×	6	.0	9	8	0	8	4	6	4
×	7	.1	1	4	4	3	2	0	8
×	8	.1	3	0	7	7	9	5	2
×	9	.1	4	7	1	2	6	9	6
×	10	.1	6	3	4	7	4	4	0

Now to elucidate this scale we will take .01634744 for the tax on one dollar; .03269488 for the tax on two dollars; .04904232 for the tax on three dollars; .06538976 for the tax on four dollars; .08173720 for the tax on five dollars; .09808464 for the tax on six dollars; .11443208 for the tax on seven dollars; .13077952 for the tax on eight dollars; .14712696 for the tax on nine dollars, and .16347440 for the tax on ten dollars.

3. When we want to know the tax on 20, move the decimal point of No. 2, one figure to the right, thus, 0.3269438; on 30, move the decimal point of No. 3, one figure to the right, thus, 0.4904232; on 40, move the decimal point of No. 4, one figure to the right, thus, 0.6538976; &c. to ten.

4. For the tax on 100, move the decimal point of No. 1, two figures to the right, thus, 01.634744; or, move the point of 10 one figure to the right thus, 1.6347440; for the tax on 200 dollars, move the decimal point of No. 2, two figures to the right, thus, 03.269488; for the tax on 300 dollars, move the decimal point of No. 3, two figures to the right, thus, 04.904232; and proceed down with all the numbers in the same manner as the case may require. But, mind when coming to ten, that the moving of two figures to the right will make ten hundred, that is, 1000. This number 10 must be taken notice of particularly, or some great error may arise in calculation.

It may be remarked also, that, whoever undertakes to apportion assessments by this scale, ought to be, previously, acquainted with decimals: But, let us proceed.

5. If we want to know the tax on 1000 dollars, move the decimal point of No. 1. three figures to the right, thus, 016.34744;* on 2000 dollars, move the point of No. 2. three figures to the right, thus, 032.69488; on 8000, move the decimal point of No. 8. three figures to the right, thus, 130.77952; and so for the rest of the numbers as occasion may require.

6. When the number of dollars to be taxed consists of tens, hundreds, thousands, or tens of thousands, as, 13440 the value of A's estate, hereafter mentioned, begin A's tax with ten thousand by inspecting the scale and moving the decimal point of No. 1. four figures to the right; or you may for the same tax move the point of No. 10. three figures to the right; then the tax on ten thousand dollars will be 0163.4744 or, 163.4744 the same in value.

---

* This same tax may be taken from No. 10. by moving the decimal point only two figures to the right as before mentioned; because 1 is already multiplied by 10, and ten multiplied by 100 = 1000

7. Set 0163.4744 in a memorandum, thus,

Then find the tax on three thousand by inspecting the scale at No. 3, and moving the decimal point three figures to the right and place your work in the memorandum as at b.

Then look at the scale for four hundred, and move the point of No. 4, two figures to the right, and place it in the memorandum as at c.

0163.4744
b. 049.04232
c. 06.538976
d. 0.6538976

e. 219.7095936

A.

8. Now we want the tax on 40 dollars: look at No. 4. and move the point one figure to the right, and place it in the momorandum as at d.

Add these several sums in the memorandum for A's share of the tax, which will be $ 219.7095936 as at e, over A.

9. Now we will suppose that four men, A, B, C, and D, must raise the whole tax of 565 dollars: that the estate of A is worth 13440 dollars as before mentioned, that of B, 8651, that of C, 10452, and that of D, 2019 dollars; which several sums added together, produce a sum equal to that of their real and personal estates, viz. 34562 dollars.

10. In the next place find B's part of the tax: 8651 dollars is the amount of his estate; inspect the scale at No. 8. for 8000 dollars and move the decimal point three figures to the right, thus, 130,77952; place this number in a memorandum as in the case of A, thus, then for 600, inspect No. 6. and move the point two figures to the right as at f; for 50 move the point of No. 5. one figure to the right as at g; and for 1, insert No. 1, as at h.

Thus we find B's share of the tax to be $ 141.42170344 as at j, over B.

130.77952;
f. 09.808464
g. 0.8173720
h. .01634744

j. $ 141.42170344

B.

11. C's estate is 10452 dollars. Inspect the scale at No. 1. and move
the point four figures to the right, thus, 0163.4744;
for 400, two figures to the right of No. 4. thus, 06.538976;
for 50, one figure to the right of No. 5. thus, 0.8173720;
for 2 insert No. 2. thus, .03269488:

Thus the share of C, is $ 170.86344288

C

12. D's estate is 2019 dollars:
Move the point at No. 2. three figures to the right
for 2000 dollars, thus, 032.69488;
for 10 dollars, copy No. 10. thus, .16347440;
for 9 dollars, copy No, 9. thus, .14712696:

D's share of the tax is $ 33.00548136
C's, 170.86344288
B's, 141.42170344
A's, 219.7095936

Proof, $ 565.00022128

If we wish to know how much the tax would be on a cent or cents, move the decimal point two figures to the left by prefixing ciphers which is the same as dividing by 100.

EXAMPLES.

For the tax on one cent, prefix two ciphers to No. 1. thus, .00016347+; for two cents prefix two ciphers to No. 2. thus, .00032694+; for three cents prefix two ciphers to No. 3. thus, .00049042+; and so on for the residue of the scale.

This rule is divided into two parts, *Alligation Medial* and *Alligation Alternate*. It signifies a linking together; it enables us to find the value or mean rate of a pound, an ounce, a bushel, a gallon, &c. of any mixture when several sorts are combined at different prices. And to the contrary, we find the several quantities to be mixed, when their prices or rates are given.

ALLIGATION MEDIAL.

RULE.

As the *sum total* of the different articles,
is to the *amount* of their combined value;
So is any *particular part* of the whole mixture,
to its *particular value*.

EXAMPLE 1.

Suppose we mix 4 bushels of pease at $ 1. a bushel with 6 bushels of oats at 50 cents a bushel, 2 bushels of rye at $ 1.25 a bushel, 3 bushels of corn at 75 cents a bushel, and 8 bushels of buckwheat at 40 cents a bushel; what will a bushel of this mixture be worth? Answer 65 cent.

OPERATION.

4	bushels	of peas,	at	100 cents	=	400 cents.
6	do.	of oats,	at	50	=	300
2	do.	of rye,	at	125	=	250
3	do.	of corn,	at	75	=	225
8	do.	of buckwheat,	at	40	=	320
—						——
23 bushels make the sum total of the different articles.						Amount of their combined value, 1495 cents.

	A.	Cents.	A.
Now say, As 23 articles, or bushels,	23 :	1495 : :	1

are to 1495 cents combined value;
So is 1 bushel,
to its particular value.

23)1495(65 cents.
138
——
.115
115

Or,

	A.	A.	Cents.
Say, As 23 articles,	23 :	1 : :	1495

are to 1 article;
So are 1495 cents,
to 65 cents, the answer.

÷ 23)1495(65 cents.
138
——
.115
115

EXAMPLE 2.

Mix 5 gallons of wine at $2. a gallon, with 8 gallons at $2.50 a gallon, 10 gallons at $3. a gallon, and 7 gallons at $4. a gallon; at what price can a grocer afford to sell this mixture by the gallon?

Answer, $2.93 and .33+ of a cent.

OPERATION.

5	gallons of Wine	at 200 cents	=	1000 cents.
8	do.	at 250	=	2000
10	do.	at 300	=	3000
7	do.	at 400	=	2800
—				——
30	Sum total of the different articles.			8800 Amount of their combined value.

As 30 articles, or gallons,
are to 8800 cents combined value;
So is 1 gallon,
to its particular value.

```
 g.  cents.   g.
30 : 8800 : : 1
   30)8800(293.33+
      60
      —
      280
      270
      —
      .100
        90
        —
        100*
         90
         —
         100*
          90
          —
          10
```

* A star or asterisk used in this manner, denotes the addition of decimal ciphers as has been noted before.

ALLIGATION ALTERNATE,

Operates to the reverse of Alligation Medial, because the rate and prices are given to find the quantities to be mixed.

RULE.

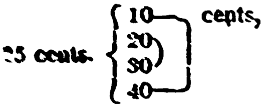
1. Place the *prices* of the *simples* in a column, beginning with the least uppermost, increasing with the next least, till you come to the foot of the column with the greatest.
2. Place the *given rate* or *mean price* on the left of the column.
3. Connect, with a circular line, the price of a simple, which is *less* than the mean rate, with one which is *greater* than the mean rate; and so to the contrary, a *greater* with a *lesser*.
4. Take the difference between the mean rate and each simple, and place to the right, opposite to that other simple with which it is connected.
5. Carry out to the right, in a column, the amount of that difference, at the price which stands opposite in the first column.

EXAMPLE 1.

A tobacconist has four sorts of tobacco; one at 10 cents, another at 20 cents, a third at 30 cents, and a fourth at 40 cents a pound: he wishes to know what quantity of each may be mixed, so that he can afford to sell at 25 cents a pound?

Here we will call 25 cents, the given or mean rate, and 10, 20, 30, 40, prices of the simples.

OPERATION.



```
15 lb. at 10 cents,  =  150 cents.
 5 do. at 20         =  100
 5 do. at 30         =  150
15 do. at 40         =  600
 —                      —
40 No. of lbs.       $10.00 Amount of the
25 mean rate.                  [simples.
```

Mean rate, ×

Proof, $10.00

The answer is 15 lb. at 10 cents, 5 lb. at 20 cents, 5 lb. at 30 cents, and 15 lb. at 40 cents.

EXAMPLE 2.

Sugar at 10 cents a pound, at 20 cents, at 30 cents and at 40 cents, being ready for a mixture, required how many pounds of each to make a composition worth 25 cents a pound?

Ans. 5lb at 10 cents, 15lb. at 20, 15lb. at 30, and 5lb. at 40

Operation.

Simples.

	Simples		
Mean rate 25.	10	5 lb. at 10 cts.	= 50
	20	15 lb. at 20	= 300
	30	15 lb. at 30	= 450
	40	5 lb. at 40	= 200
Am't of articles or simples,		40 lb.	$10.00 am't of the simples.

Proof by Alligation Medial.

lb. cts. lb. { If 40 lb. simples cost 10 dollars, what
÷ 40 : 1000 :: 1 { will 1 lb. cost?
80 (25 lb. answer.
200
200

EXAMPLE 3.

A farmer mixing oats at 40 cents a bushel, with peas at 75 cents a bushel, and corn at 100 cents a bushel, required how much of each sort to make a mixture worth 70 cents a bushel?

Ans. 35 bushels at 40 cents, 30 at 75 cents, and 30 at 100 cents.

Operation.

70	40	5 + 30 = 35 at 40 c.	= 1400 c.
	75	30 at 75 c.	= 2250 c.
	100	30 at 100 c.	= 3000 c.
No. of bushels or simples,		95	6650 c. amount of simples.

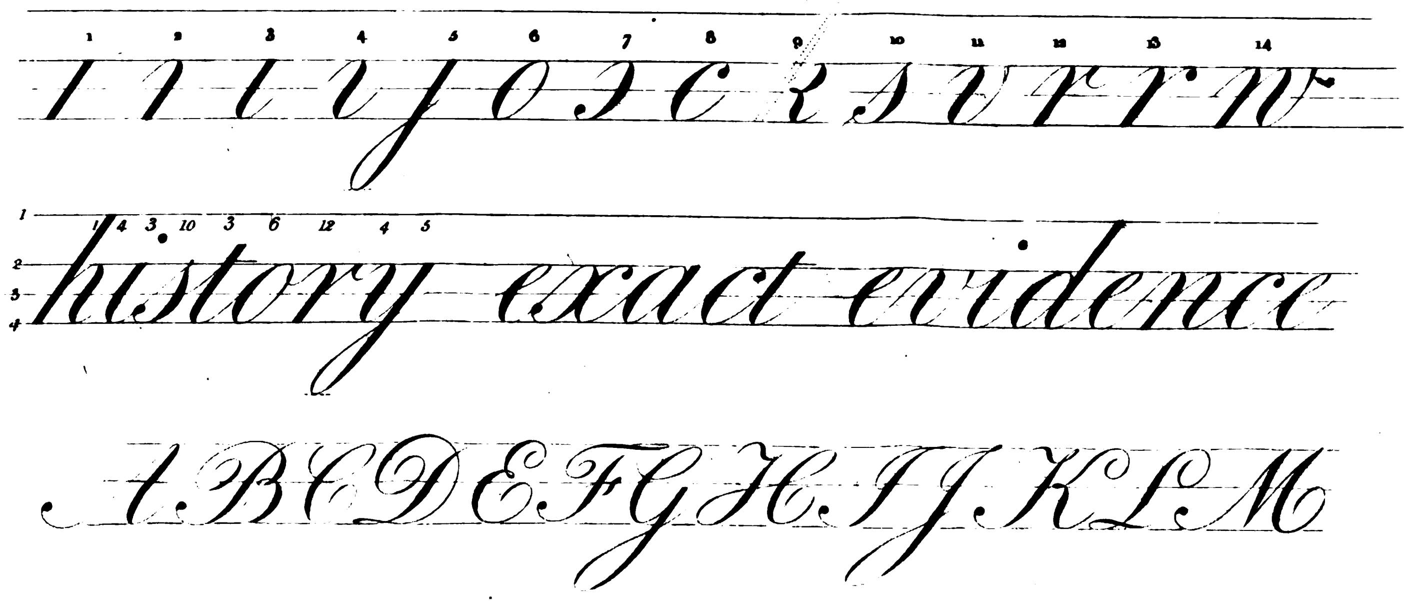
Proof.

As 95 bushels, or simples, are to 6650 cents; so is 1 bushel to its value.
÷ 95 : 6650 :: 1
665 (70 answer in cents.
...0

Note.—When more differences than one happen against any simple, as at 40, then such differences must be added together, as 5 + 30 = 35.

Many and various operations may be wrought in Alligation Alternate, and Alternation Total; but these examples must suffice for an introduction. More useful matter claims a preference, and the want of room forbids the insertion of several curious subjects.

Elements of Penmanship



N O P Q R S T U V W X Y Z

a b c d e f g h i j k l m n o p q r ſ s t

u v w x y z z &c re va we

1 2 3 4 5 6 7 8 9 0 ¼ ½ ¾ 1 2 3 4 5 6 7 8 9 0.

PENMANSHIP.

FORMATION OF LETTERS.

THE ART OF PENMANSHIP is obtained by frequent trials in imitating good specimens or copies, made for that purpose. The modern penmen, such as the late Mr. *Towne*, Mr. *Forster*, of Baltimore, and Mr. *Dean*, of New-York, have afforded us elegant and modern specimens, well worthy of imitation.

Some one of their copies ought to be where we can often take a view of the formation of the letters and cuts. Imitations may be made with a piece of chalk on a board, or with a pencil on a slate, rather than to take a view and make no trial in forming those characters.*.

If some person would employ Mr. Fairman, of Philadelphia, to delineate and engrave a set of copies for the use of schools, I am of opinion that the performance would be well accepted by the public, and at the same time afford to teachers modern samples which would appear lively and elegant.

As to rules in writing, there are many; and almost every writing master has some small variation from his rival. These differences, however, are not of the greatest importance: it is true that some rules are better than others; but the main object is to instruct learners in the easiest and most expeditious mode of becoming good writers or good penmen. This may be done by adopting certain simple rules for the beginning, the ending, the joining, the length, the width, the inclination and proportion of letters.

RULES for imitating the elements of penmanship, as inserted in this book, entitled "Every man his own Teacher," may be expressed thus:—

1. The Stem No 1, may be formed by placing the nib of the pen in such a manner as to form the top of the stem square and parallel with the upper line; then bring down a bold and quick stroke to the lower line, suddenly taking off the pen and leaving the impression square at the bottom.

2. Begin the inverted Ell, or No. 2, with a hair stroke on the middle line, proceed to the upper line, and from that gradually form a bold stroke, which bring down and take off the pen at the lower line, suddenly, as in forming the stem.

3. The Direct Ell, or No. 3, may be begun in manner as that of the stem, brought down with a bold stroke, and turned gradually with a hair stroke to the middle line.

4. Begin the Curved Ell, or No. 4, on the middle line with a hair stroke, turn the top like the inverted ell, and the bottom like that of the direct ell.

5. Form the Jay, or No. 5, like the loop of the capital G, with a small degree of curvity, the plate being imperfect by having the loop of the y, j, and g, too straight.

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* It would be profitable for young teachers to visit Mr. Picket's school in New-York, and observe his mode of instruction. His Telegraphic Slates are of the greatest utility in teaching; and his pupils are more independently expert in penmanship, arithmetic, grammar, and geography, than any I have ever seen. The method of lecturing pupils in arithmetic, at Baltimore College, Maryland, is also well worthy the attention of young teachers.

6. Let the learners proceed and make the o, the inverted c, the c, k, v, r and w; then begin to inform them, that these marks are the component parts of the alphabet: begin with the h on line No. 1, and bring down a stem to line No. 4; then make a curved ell, and join the hair stroke to the stem of the h, or line No. 3, and carry its other hair stroke up to No. 3 also, to join the i on that line, as in the word history on the plate. See the plate. Have the plate in view and point to each character.

7. Then observe, that with a stem and a curved ell, we form an h; with a curved ell and a j, we form a y; with an o, and a direct ell, we form an a, or an a and d; and, with an inverted ell and a curved ell, we form an n, &c.; giving at the same time such other pertinent lectures, as the master by his ingenuity may invent.

8. Observe to pupils, that all strokes in Roman text partake of an oval form, except the stem. For instance, continue the hair stroke of a c, with fine dots, and it will form an o; continue the hair strokes of a curved ell, and they will form a double o; continue the loop and the upper part of the capital G, and each will form a large O; continue each particular stroke of a capital B, and they will form an O three times; and these observations will hold good with regard to almost every letter, great and small, in the alphabet.† When any capital letter is ended with a flourish, instead of a curl, let the flourish be formed in shape like an oval; and not suffer lines to cross each other, so as to form right angles; but always endeavour to leave them in such position as to cross obliquely, forming acute angles. And this caution may apply to all scribblers, who are dashing cuts and flourishes, on slates or paper, for pastime or for improvement.

Aim to cut a flourish in such manner, as to have the beginning and ending of the stroke meet, and at the same time form an oval. These ovals may stand with an inclination, like the O or any other letter in the text hand, or, they may lie horizontally. A horizontal oval, or a segment of it, will help in forming an elegant capital D, L, or Q.

When capitals, such as B, F, I, K, P, R, S, and T, are ended with a curl, let them stand in such position, and be of such shape, as to cut through the middle of an O; that is, if we begin at the curl, and dot an O about the body of the letter, the O will be bisected.‡

HOW TO HOLD A PEN.

In the first place, let the body be stationed in an easy posture, resting more on the left side than on the right, where the light comes from the left hand; curl the ring-finger, or that next to the little finger, into the hollow of the hand, and rest the hand on the little finger; also rest the arm, half way from the elbow to the wrist, on the edge of the writing desk or table. When children first begin to write, furnish them with a slate and pencil; teach them how to hold the pen or pencil, and by degrees learn them to point the upper end over the right shoulder; but as this manner of holding the pen is unnatural at first, bring it on by degrees; give them an easy copy, such as the stem or inverted ell, show them how to place the marks equidistant, with spaces between about the width of a small n, make the marks of one inclination and of equal length. At the same time promise the little tyroes, pen, ink, and paper, when they become capable of holding their pens correctly.

It is said, that "the use of the pencil is a detriment in holding the pen;" but experience has proved to the contrary, in thousands of instances.

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† See Mr. Towne's copies, New-York.

‡ Bisected, divided into two equal parts.

HOW TO MAKE A PEN.

1. In the first place have two penknives, of narrow thin blades, that are made of the best steel. One knife with a thick basil edge as it comes from the cutler, and another with a more thin edge, are necessary in making good pens for writing elegant copies in school. Shape the nib of the pen with the thick-edged knife, scrape the back of the nib upwards, in such manner, that will make it rough about half an inch, and check the end of the unfinished broad nib, with the edge of the knife; then, place the thumb-nail on the back of the quill, so far up as you mean to have the split extend, and strike a sudden stroke with the knife to split the nib. This scraping roughly upwards, is to alter the texture of the quill, so that it may split clearly, without a roughness commonly called ganders' teeth; for no pen will write smoothly, and make fair strokes, if the split be rough.

2. Immerse a number of these half-made pens in water, and let them remain there till they are wanted for use; then, with the thin-edged knife, finish the nibs for coarse or fine hand writing as you chuse; expose them to the air a short time to gain their strength and spring, but not too long, lest they curl out of shape. The immersion is to soften the quill, that it may not turn the edge of the thin knife, and the scraping and splitting of the quill when dry, is done because a quill will not split clearly when wet. The sharper the knife is when nibbing a pen, the more fine will be the hair strokes, and the more smooth will be the bold strokes.

3. When you are sharpening a penknife, observe in what shape the edge came from the cutler; that is, a long basil is on the side that slides next to the quill, and a very short basil on the opposite side; hone the thick-edged knife in the same manner as it was at first, but make the knife you nib with, more thin and keen. In forming the point of a pen, regard must be had to the thickness of the quill: if the quill be thick, the point and split may be long, and the cheeks shaved till thin, then scraped till smooth, to make them pliable and elastic. But when you are shaving the cheeks, be careful and avoid taking off any substance from the back of the quill where the split runs; leave that part, generally, as thick as nature has formed it; because this will preserve the elasticity or springy power of the pen. One exception however may be noticed here; that is, before you cut off the nib of the pen, pare the back of the nib, beginning upward about one sixteenth part of an inch, and take off a slice downward, forming the nib into a perfect point; this will improve the fineness, but will not decrease the elasticity.

4. If a quill be thin, the split and point of the pen must be short, and the cheeks not shaven; but such quills will not afford a pen suitable for handsome work.

For fine drawing, such as landscapes, or the representation of streams on a map, a house, a lake, a mill-pond, or the like, procure crow-quills: with these you may make a fine hair stroke, nearly equal in delicacy, to those impressed on a copper-plate.

5. REMARK ON QUILLS.

When you stop writing with a good pen, leave it in the ink, or in some moist body, as, sponge, cloth, cotton, or the like, to keep it from curling out of the natural shape; but if a pen want mending, wipe it clean with a piece of soft paper, and lay it down to dry. In chusing quills, endeavour to obtain those which grow in the left wing; the curvature of such quills will fay to the forefinger of the right hand, and are more easily rolled and governed, than those that grow in the right wing. Respecting the best quills, let experience and frequent trials in using them be the instructor; for my part I chuse quills in their natural state or unmanufactured, that have hung in a garret or some dry place for about two years. A manufactured quill is like a high tempered edge tool; the edge soon crumbles off, though ever so keen at first.

OF BOYS MAKING PENS.

Here it may not be amiss to mention the necessity of boys having a knife, or knives if they can afford the cost, and of their learning seasonably to make and mend pens. Many persons who can write a decent hand, are obliged to call on their friend for a pen; and by such dependence lose many opportunities of writing, by which they sometimes suffer pecuniary loss, and often lose time which ought to be taken up in improvement. When a boy or girl can write a decent text hand, or what is commonly called copy-hand, they ought to be instructed how to make a pen. From this early acquisition of knowledge in making a pen, will arise a twofold profit or advantage; it will not only afford great relief to the Teacher, but will give to the learners independence in penmanship.

GOOD INK.

This is a requisite in penmanship which is too frequently neglected; it is either of a poor quality, or suffered to become dirty in the standish. When you quit writing, stop or cover your standish if you mean to make elegant work: and whenever the cotton becomes foul, wash it or throw it away.

The British ink-powder, or the ink-cake, extracted or dissolved according to the printed directions accompanying the powder and cakes, will answer every purpose in writing as respects good ink. Japan ink is well adapted to the writing of copies which resemble copper-plate impressions, and when these two sorts of ink are mixed together, the composition is apparently improved. Due regard ought to be paid to the thickness or thinness of ink; if it be too thin, the colour will be pale, if too thick, the strokes will not be smooth, and if become frozen, it will be spoiled for any handsome writing.

Mr. *Ribancourt* gives us the following recipe for making an excellent black ink, which, he says, will not become decomposed nor fade, but increase in blackness although exposed to the air, sun, dust, smoke, and moisture.

RECIPE.

Take 8 ounces of nutgalls—4 ounces of ground or rasped logwood, and boil them one hour in 12 pounds of water, or until one half is evaporated; it is then percolated, or strained through a hair sieve, and to this liquid are added sulphat of iron or copperas 4 ounces—gum arabic 3 ounces—sulphat of copper or blue vitriol 1 ounce—sugar candy 1 ounce. This solution is well stirred and suffered to stand twenty-four hours; it is then poured off from the sediment and kept close stopt in glass or stone jars.

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